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THE BLACK FLIES (DIPTERA: SIMULIIDAE) OF COLORADO: AN ANNOTATED LIST WITH KEYS, ILLUSTRATIONS AND DESCRIPTIONS OF THREE NEW SPECIES

by

B.V. Peterson and B.C. Kondratieff

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AT THE ACADEMY OF NATURAL SCIENCES
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The Black Flies (Diptera: Simuliidae) of Colorado: An Annotated List With Keys, Illustrations and Descriptions of Three New Species

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ABSTRACT—An annotated list of the six genera and 29 described species currently known from Colorado is provided, along with keys and illustrations for their identification in the adult, pupal and larval stages. One unidentified species of *Cnephia* is included in the key to verify the presence of the genus in Colorado. One unidentified species of *Metacnephia* and one unidentified species of *Prosimulium* are also reported for the state but are not included in the key. Three new species, *Metacnephia coloradensis*, *Prosimulium opleri* and *P. wui*, are described and illustrated. Brief comments, and biological notes with altitude, seasonal, and geographic distributions are provided for each species.

INTRODUCTION

The black flies of Colorado and the southern Rocky Mountains are poorly known, with only isolated descriptions (Peterson 1989), and a few species lists for specific streams (Elgmork and Saether 1970, Saether 1970, Ward 1986, Bushnell et al. 1987) available in the literature. A number of authors including Cockerell (1893), Coquillett (1898, 1900, 1902), Aldrich (1905), Malloch (1914), McAtee (1922), Dyar and Shannon (1927), Stains and Knowlton (1943), Vargas et al. (1943), Nicholson (1952), Peterson (1960), Stone (1965), Stone and Boreham (1965), and Ward and Kondratieff (1992) briefly mention the presence of various black fly species in Colorado. However, there is no comprehensive treatment, or even a current list of the species known from the state.

The following keys, annotated list of genera and species, and illustrations are presented to provide a framework for various biological and disease transmission studies in progress on the black flies of the eastern front of the Colorado Rocky Mountains, for current and future ecological studies, and for more comprehensive studies on the systematics of this important regional fauna.

The diverse geomorphology of Colorado, with elevations ranging from 1,020 m at the Kansas border to numerous peaks exceeding 4,000 m in the Rocky Mountains, allows for a wide variety of lotic habitats. Colorado is readily divided into three broad physiographic regions: plains, mountains, and plateaus (Fig. 1). The eastern two-fifths of the state is part of the Great Plains, originally grasslands that extended from the base of the mountains to the Kansas border, interrupted only along permanent streams by lines of cottonwood (*Populus* spp.) and willow (*Salix* spp.). Two major drainage systems, the South Platte and the Arkansas, cross the Colorado plains. Tributaries of these two systems have etched the prairie surface, leaving eastern Colorado with a gently rolling topography (Chronic and Chronic 1972). Typically, the streams meander through the shortgrass region of the plains and have sandy bottoms with some woody debris. However, many streams have been channelized or impounded, destroying black fly larval habitat. Black fly habitats in this province include trailing vegetation and any available wood

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or rocks as attachment sites in riffles. Some of the resident species include *Simulium bivittatum* Malloch, *S. griseum* Coquillett, *S. meridionale* Riley, *S. vittatum* Zetterstedt, and *S. aureum* Fries. Species, such as *S. vittatum* and *S. bivittatum*, often can be found abundantly in the many irrigation ditches and canals of this region.

The Southern Rocky Mountains rise abruptly in the central portion of the state, in ranges that almost form ranks of north-south ridges. From lakes and springs arise rivers such as the Colorado, Yampa, Rio Grande, South Platte, and Arkansas. Here there are four recognized life zones established primarily by altitude and latitude: foothills, montane, subalpine, and alpine. The foothills are typified by steep dry slopes. Ponderosa Pine (*Pinus ponderosa* Dougl. ex P. and C. Laws) occupy mesic habitats, and shrubs, such as sagebrush (*Artemisia tridentata* Nutt.) and rabbitbrush (*Chrysothamnus* spp.), dominate dry slopes. Some black flies typical of these streams are *Simulium tuberosum* Lundström, *S. canadense* Hearle, and *S. arcticum* Malloch. Streams in the montane and subalpine zones are usually cascading water courses with riffles and pools interspersed with gramineous meadows. Typical overstory trees in the subalpine zone are Subalpine Fir (*Abies lasiocarpa* (Hook.) Nutt.), Engelmann Spruce (*Picea engelmannii* Parry ex Engelm.), and Lodgepole Pine (*Pinus contorta* Dougl. ex Loud.). Common black flies of this region include *Prosimulium exigens* Dyar and Shannon, *P. onychodactylum* Dyar and Shannon, *Simulium arcticum*, *S. hunteri* Malloch, and *S. tuberosum*.

The Colorado Plateau is the westernmost region in the state, and is characterized by semidesert shrublands and by flattopped plateaus and mesas overlooking steep gorges cut by rivers. Many of the smaller streams in the area become intermittent or dry after snow melt. The larger rivers, e.g., Yampa, Dolores, White, San Miguel and San Juan, and especially the Colorado, have been impounded along their lengths to form reservoirs for water storage. Much of this area receives less than 30 cm of rainfall annually. Sagebrush, rabbitbrush, and tamarisk (*Tamarix ramosissima* Ledeb.) are common riparian plants. Black flies common to this region include *Simulium vittatum*, *S. arcticum*, and *S. piperi* Dyar and Shannon.

There are eleven major drainage basins in Colorado. Waters west of the Continental Divide (indicated by a dotted line on Fig. 1) flow into the Colorado River and its tributaries, eventually entering the Gulf of California. Eastern slope waters flow into the Rio Grande, North and South Platte, and Arkansas River systems, and eventually reach the Gulf of Mexico. The large traversing watercourses undoubtedly have allowed the dispersal of black fly species from more southern, western or eastern regions of North America into Colorado. However, zoogeographical patterns are difficult to determine due to the probable extirpation of lower elevational black fly populations by the multitude of dams, diversions and other forms of stream regulation. The Platte River system of Colorado, Wyoming and Nebraska has at least 194 reservoirs of capacities greater than 0.6hm3 and hundreds of additional agricultural dewatering diversion canals (Kirchner and Karlinger 1983). Ward et al. (1986) emphasized that only, "remnants of a remarkable fauna remain..." in large river systems such as the lower Colorado. Some southwestern species of black flies, such as *Simulium solarii* Stone and *S. encisoi* Vargas and Díaz Nájera, may have dispersed northward into the lower Rio Grande River drainage of Colorado but apparently are not there now. We have no evidence of such dispersion, and the two species mentioned have not been collected in Colorado.

MATERIALS AND METHODS

We have verified the presence in Colorado of six genera and 29 described species, plus three new species described below, and three still undetermined species. Two additional species, *Prosimulium decemarticulatum* (Twinn), and *Simulium corbis* Twinn are included in the keys; the former has been reported from the state but not verified, and the latter is not yet known from Colorado but probably occurs in the state. A number of species reported from surrounding states probably occur in Colorado but have not been collected within its borders (see below). The species treatments refer to morphospecies. No attempt has been made to study the Colorado fauna using cytological or biotechnological methods. The majority of records reported below are from collections made by the authors over the past several years, supplemented by material housed in the National Museum of Natural History,

Smithsonian Institution (USNM), Washington, D.C., and the Colorado State University (CSU), Fort Collins, Colorado. Although we list some records from the literature, exhaustive efforts were not made to glean every record published for Colorado. Important collections were donated by R.H. Jones and W.L. Kramer, both formerly with the Arthropod-Borne Animal Disease Research, Agricultural Research Service, USDA, Denver, Colorado. Other material examined, and some records, were generously provided by K.P. Pruess, Department of Entomology, University of Nebraska, Lincoln, Nebraska, who has collected in selected areas of the state for several years, and G.W. Byers, Department of Entomology, University of Kansas, Lawrence, Kansas. The cytological determinations mentioned in various species treatments, unless otherwise indicated, were made by P.H. Adler, Department of Entomology, Clemson University, Clemson, South Carolina. Voucher specimens of all available life history stages are deposited in the USNM, with other available specimens in the CSU collection.

Acronyms for the type depositories mentioned in the text are as follows:

CNC	Canadian National Collection, Ottawa, Ontario, Canada.
CSU	Colorado State University, Ft. Collins, CO.
NHM	Natural History Museum, London, England.
Ukal	Snow Entomological Museum, University of Kansas, Lawrence, KA.
USNM	National Museum of Natural History, Smithsonian Institution, Washington, D.C.
ZIUL	Zoological Institute, University of Lund, Lund, Sweden.

The following keys are modified from those of Peterson (1960, 1970b, 1981), Davies et al. (1962), and Wood et al. (1963). The key to both the genera and species are combined for ease of use and conservation of space. Illustrations are provided for all species. To complement these illustrations, we also include in the keys references to figures in other publications that show different views of some of the features used for identification. The species of black flies most commonly collected in Colorado should run fairly easily through the keys. However, some species are very difficult to separate and should be examined by a specialist. If difficulties of identification arise, we suggest the keys in Wirth and Stone (1956), Peterson (1960, 1970b, 1993), and Currie (1986) be tried. These keys, in combination, include many other species known from the western states that are not treated in this work.

In constructing the keys, the authors assume the reader is familiar with the literature on the family, the structure of the various life history stages, and the terminology used in the Simuliidae. If not, the user is referred to the glossary of this work, and to the general treatment of the family by Peterson (1981) and the supplementary literature given in the bibliography of that paper. Characters in the keys that are not designated as either male or female, apply equally to both sexes. Larval characters mentioned apply only to those of last instar larvae.

The following data is given for each species: the altitudinal range of the material in our collections, distribution records listed by county in alphabetical order, followed by the earliest and latest collection dates within each county, and the life history stages of our specimens (A= adults, P= pupae, L= larvae). A complete list of locality data is available from the senior author upon request. The literature cited includes only those papers of most significance to this work.

CHECKLIST OF COLORADO BLACK FLIES

Family Simuliidae Newman, 1834
Subfamily Simuliinae Newman, 1834
Tribe Prosimuliini Enderlein, 1921

Cnephia Enderlein, 1921
1 unidentified species

Metacnephia Crosskey, 1969
coloradensis Peterson and Kondratieff, new species
1 unidentified species

Piezosimulium Peterson, 1989
jeanninae Peterson, 1989

Prosimulium Roubaud, 1906
(*Helodon* Enderlein), 1921
onychodactylum Dyar and Shannon, 1927 [complex]
(*Parahelodon* Peterson), 1970
decemarticulatum Twinn, 1936 [complex]
(*Prosimulium* Roubaud), 1906
exigens Dyar and Shannon, 1927
flaviantennum (Stains and Knowlton), 1940
frohnei Sommerman, 1958
fulvum (Coquillett), 1902
opleri Peterson and Kondratieff, new species
travisi Stone, 1952
wui Peterson and Kondratieff, new species
1 unidentified species

Stegopterna Enderlein, 1930
mutata (Malloch), 1914 [complex]

Tribe Simuliini Newman, 1834
Simulium Latreille, 1802
(*Byssodon* Enderlein), 1925
meridionale Riley, 1887
(*Eusimulium* Roubaud), 1906
aureum Fries, 1824 [complex]
(*Hearlea* Vargas, Martínez Palacios and Díaz Nájera), 1946
canadense Hearle, 1932
(*Hellichiella* Rivosecchi and Cardinali, 1975
canonicola (Dyar and Shannon), 1927 [complex]
(*Hemicnetha* Enderlein), 1934b
virgatum Coquillett, 1902 [complex]
(*Nevermannia* Enderlein), 1921
pugetense (Dyar and Shannon), 1927 [complex]
vernum Macquart, 1826 [complex]
(*Psilopelmia* Enderlein), 1934a
bivittatum Malloch, 1914
griseum Coquillett, 1898
venator Dyar and Shannon, 1927
(*Psilozia* Enderlein), 1936
argus Williston, 1893
vittatum Zetterstedt, 1838 [complex]
(*Simulium* Latreille), 1802
arcticum Malloch, 1914 [complex]
decorum Walker, 1848 [complex]
defoliarti Stone and Peterson, 1958 [complex]
hunteri Malloch, 1914
jacumbae Dyar and Shannon, 1927
piperi Dyar and Shannon, 1927
tuberosum (Lundström), 1911 [complex]
venustum Say, 1823 [complex]
verecundum Stone and Jamnback, 1955 [complex]

Species That Might Occur In Colorado

There undoubtedly are other species, in addition to those listed below, that might occur in Colorado; those in the following list (with known distributions) are among the most likely candidates to be found in the state.

Prosimulium Roubaud, 1906
(*Prosimulium* Roubaud), 1906
daviesi Peterson and DeFoliart, 1960 [Utah]
dicum Dyar and Shannon, 1927 [British Columbia, California, Utah, New Mexico]
longilobum Peterson and DeFoliart, 1960 [Utah]
shewelli Peterson and DeFoliart, 1960 [Utah]
uinta Peterson and DeFoliart, 1960 [Utah]
Metacnephia Crosskey, 1969
freytagi (DeFoliart and Peterson), 1960 [Wyoming]
jeanae (DeFoliart and Peterson), 1960 [Utah, Wyoming]
villosa (DeFoliart and Peterson), 1960 [Alberta, Utah, Wyoming]
Simulium Latreille, 1802
(*Hemicnetha* Enderlein), 1934b
solarii Stone, 1948 [New Mexico, Texas, Mexico]
(*Nevermannia* Enderlein), 1921
wyomingense Stone and DeFoliart, 1959 [Idaho, Utah, Wyoming]
johannseni Hart, 1912 [Wyoming, Nebraska to New York, south to Mississippi]
(*Psilozia* Enderlein), 1936
encisoi Vargas and Díaz Nájera, 1949 [California, New Mexico, Texas, Mexico]
(*Simulium* Latreille), 1802
corbis Twinn, 1936 [Alaska to Newfoundland, south to Utah]
petersoni Stone and DeFoliart, 1959 [California, Nevada, Utah, Wyoming]

Questionable Literature Records

The records included under this heading are those that obviously are based on misidentifications, or those we have not collected, seen or otherwise been able to verify. Some of the following species might indeed occur in Colorado but, at this time, we cannot be certain of such records.

Ectemnia Enderlein, 1930
invenusta (Walker), 1848 [as *Simulium*; Coquillett 1900; misidentification].
Metacnephia Crosskey, 1969
saileri Stone 1952 [as *Cnephia saileri*; Saether 1970] (misidentification of *Metacnephia coloradensis* n.sp. Some workers consider *saileri* a synonym of *pallipes* (Fries)).
Prosimulium Roubaud, 1906
(*Parahelodon* Peterson), 1970b
decemarticulatum (Twinn), 1936 [Lichtwardt and Williams 1988]
(*Prosimulium* Roubaud), 1906
dicum Dyar and Shannon, 1927 [Ottonen 1966] (misidentification of *exigens* Dyar and Shannon 1927 (see Peterson 1970b)).
esselbaughi Sommerman, 1964 [Elgmork and Saether 1970; Saether 1970] (this record probably refers to *travisi* Stone 1952).
hirtipes (Fries), 1824 [Bushnell et al. 1987] (not Nearctic).
ursinum Edwards, 1935 [Elgmork and Saether 1970; Saether 1970; Bushnell et al. 1987] (misidentifiction of *Prosimulium wui* n. sp.).

KEY TO THE GENERA, SUBGENERA, AND SPECIES OF COLORADO BLACK FLIES

ADULTS

1 Radial sector (Rs) of wing with a long, distinct fork that is conspicuously longer than its petiole; Costa (C) with fine setae only, not interspersed with spinules; basal section of Radius (R) always setose (Fig. 6). Calcipala and pedisulcus absent (Fig. 9) **2**

— Radial sector (Rs) of wing unforked; Costa (C) with spinules interspersed among its fine setae; basal section of Radius (R) setose or bare (Fig. 5). Calcipala and pedisulcus present or absent (Figs. 10-13) **11**

2 Male terminalia with ventral plate of aedeagus somewhat W-shaped in terminal view, and somewhat M-shaped in ventral view; gonocoxite with a prominent ventromedial lobe that articulates with a prominent, sclerotized, setose plate situated anteriorly between the lobes of the 2 gonocoxites; sperm pump present (Figs. 29-35). Female unknown . . . . . Genus *Piezosimulium* Peterson ..... ***jeanninae*** Peterson

— Male terminalia with ventral plate of aedeagus not W-shaped in terminal view, nor M-shaped in ventral view; gonocoxite with, at most, a small ventromedial lobe; without a sclerotized, setose plate anteroventrally between gonocoxites; sperm pump absent. Female variable; claw with or without a variably sized subbasal tooth (Figs. 10-13). . . . Genus *Prosimulium* Roubaud **3**

3 Antenna with 8 flagellomeres, dark in male, yellow in female. Male with ventral plate of aedeagus broad, flattened dorsoventrally, without a ventrally directed lip; basal arms short; proximal margin of dorsal surface produced beyond tips of basal arms as a long, slender, hollow, tubelike process with which base of median sclerite is fused; median sclerite with only minute apical arms so that it appears almost square at apex; paramere free, not connected to basal arm of ventral plate (Fig. 63) (Fig. 36, in Peterson 1970b). Female spermatheca subcircular, conspicuously pigmented. Arm of genital fork slender at base, abruptly expanded distally into a weakly sclerotized terminal plate (Fig. 64) (Fig. 6, in Peterson 1970b). . . . Subgenus *Parahelodon* Peterson ..... ***decemarticulatum*** (Twinn)

— Antenna with 9 flagellomeres, varying in color. Male with ventral plate of aedeagus varying in shape, if compressed dorsoventrally then dorsal surface convex; anteromedial margin of dorsal surface not produced tubelike beyond tips of basal arms; basal arm longer and broader; median sclerite distinctly Y-shaped; paramere attached to basal arm of ventral plate. Female spermatheca variable, if elongate then lightly sclerotized and with only a small differentiated circular area at junction with spermathecal duct, or if somewhat circular then with a large differentiated circular area at junction with spermathecal duct. Arm of genital fork variable but terminal plate heavily sclerotized and of different shape **4**

4 Male with ventral plate of aedeagus broad, compressed dorsoventrally but dorsal surface convex with a shallow dorsomedial depression or furrow; apical margin with, at most, a short, narrow, ventrally directed lip; in ventral view, apicolateral corners not produced laterally so that margin is evenly rounded, and greatest width is near points of attachment of basal arms; apex of gonostylus rounded with 2 apical spinules (Fig. 45) (Fig. 40, in Peterson 1970b). Female with hypogynial valves short and broadly rounded, not reaching anal lobe so abdomen appears broadly rounded or truncate distally; spermatheca elongate, lightly pigmented, with only a small differentiated circular area at junction with spermathecal duct (Fig. 46) (Fig. 11, in Peterson 1970b); claw with a strong, thumblike basal projection (Fig. 44); frons narrow, nearly parallel sided. . . . Subgenus *Helodon* Enderlein ..... ***onychodactylum*** Dyar and Shannon

— Male with ventral plate of aedeagus variably broad or narrow but not noticeably compressed dorsoventrally, with dorsal surface conspicuously concave at least proximally; apical margin usually with a prominent ventrally directed lip or emargination; gonostylus variable. Female with hypogynial valve long, narrowly rounded or pointed distally, reaching or extended beyond anal lobe so that abdomen appears rather pointed posteriorly; spermatheca variable in size and shape but with a large differentiated circular area at junction with spermathecal duct; claw simple, or at most with a small, inconspicuous subbasal tooth; frons variable. . . . Subgenus *Prosimulium* Roubaud **5**

5 Scutum with moderately long, erect to semi-erect pile, recumbent setae sparse or absent. Male eyes small, narrowly but distinctly separated along medial margins; ommatidia gradually increasing in size dorsally without a sharp line of demarcation between smaller lower ommatidia and larger upper ommatidia (Figs. 134-135) Terminalia as in Fig. 141. Female eyes small, widely separated, somewhat bulging (Figs. 136-137). Claw with a tiny subbasal tooth (Fig. 139). Terminalia as in Fig. 143 ..... ***wui*** n. sp.

— Scutum dorsally usually without erect setae except posteriorly, but often with abundant short, recumbent setae. Male eyes contiguous dorsally along medial margins; upper ommatidia abruptly enlarged dorsally and separated from smaller lower ommatidia by a variably distinct line of demarcation. Terminalia variable. Female eyes large and not bulging. Claw without a subbasal tooth (Figs. 9, 11-12) 6

6 Integument, especially of thorax, bright orange to brownish orange in both sexes. Male terminalia as in Fig. 110 (Fig. 49, in Peterson 1970b). Female terminalia as in Fig. 111 (Fig. 17, in Peterson 1970b) ..... ***fulvum*** (Coquillett)

— Integument primarily dark brown to black in both sexes. Male and Female terminalia not as above 7

7 Antenna entirely bright yellow, and legs mostly pale to bright yellow in both sexes. Male terminalia as in Fig. 85. Female terminalia as in Fig. 86 ..... *flaviantennum* (Stains and Knowlton)

— Antenna brown to black, at most with basal 2 segments yellow, and legs variable but usually darker in both sexes 8

8 Male with ventral lip of ventral plate of aedeagus compressed laterally into a narrow, ventrally rounded, keel-like structure (Fig. 78) (Fig. 62, in Peterson 1970b). Female with anal lobe projected posteriorly beneath cercus and reaching or extended slightly beyond its hind margin, spermatheca short and broadly rounded (Fig. 79) (Fig. 32, in Peterson 1970b) ..... ***exigens*** Dyar and Shannon

— Male with ventral lip of ventral plate of aedeagus broader and projected ventrally, not compressed laterally nor keel-like. Female with anal lobe not projected beneath cercus or, if so, not reaching or extended beyond its hind margin, spermatheca distinctly tapered distally and more narrowly rounded 9

9 Male semi-glossy dark brown, sparsely covered with setae. Sensory vesicle narrowly and roundly elongate, shaped much like an evaporating flask, with a distinct, narrower neck. Terminalia unusually small; ventral plate of aedeagus, in ventral view, broadest distal to basal arms, roundly tapered to a rather broad, rounded, slightly emarginate apex. Median sclerite short, stem wide with about 2 pairs of submedian longitudinal lines; arms very short, strongly divergent (Fig. 118). Female unknown ..... ***opleri*** n. sp.

— Male darker brownish black, more densely covered with setae. Sensory vesicle shorter and more rounded. Terminalia larger; of different structure (Figs. 93, 125) 10

10 Male with ventral plate of aedeagus, in ventral view, gradually narrowed distally from widest point so it appears more narrowly rounded or angular in outline than in following species; ventral lip, in terminal view, narrower and longer than in following species (Fig. 125) (Fig. 48, in Peterson 1970b). Female with anal lobe projected posteriorly beneath cercus about 1/2 the distance to hind margin of cercus; arm of genital fork with a triangular to subtriangular terminal plate bearing a longer, slender, sharply pointed, inner distal process; spermatheca tapered but more broadly rounded distally than in following species (Fig. 126) (Fig. 19, in Peterson 1970b) ..... ***travisi*** Stone

— Male with lateral margins of ventral plate of aedeagus, in ventral view, widened distally so apical margin is broader than in preceding species; ventral lip, in terminal view, broader and shorter than in preceding species (Fig. 93) (Fig. 51, in Peterson 1970b). Female with anal lobe not projected posteriorly beneath cercus, posteroventral margin broadly rounded; arm of genital fork with a subquadrate terminal plate, bearing a short, broad, inner distal process; spermatheca more strongly tapered and more narrowly rounded distally than in preceding species (Fig. 94) (Fig. 25, in Peterson 1970b) ..... ***frohnei*** Sommerman

11 Length of basal section of R rarely less than 1/3 distance from base of Rs to apex of wing; R setose dorsally; cell bm present (Fig. 4). Calcipala present or absent; pedisulcus absent or, if present, usually very shallow. Anepisternal membrane with or without a tuft of setae dorsally (Figs. 7-8) (Figs. 10-13, 27, 29, 33, in Peterson 1981) 12

— Length of basal section of R equal to or much less than 1/3 distance from base of Rs to apex of wing; R with or without setae dorsally; cell bm absent (Fig. 5). Calcipala usually well developed although sometimes reduced; pedisulcus present, usually deep and distinct, rarely a shallow depression (Figs. 10, 12-13). Anepisternal membrane bare (Fig. 12, in Peterson 1981) . . . . Genus *Simulium* Latreille 14

12 Calcipala large and prominent, lamellate, rounded apically, in posterior view overlapping and sometimes concealing base of second tarsomere (Fig. 11, 151). Anepisternal membrane bare. Male terminalia as in Fig. 152. Female claw simple (Fig. 11). Terminalia as in Fig. 153 . . . . Genus *Stegopterna* Enderlein ..... ***mutata*** (Malloch)

— Calcipala absent, or if present, usually small and bluntly pointed, in posterior view not concealing base of second tarsomere. Anepisternal membrane bare or with a tuft of pale setae dorsally. Female claw with a small subbasal tooth or a large basal thumblike projection 13

13 Calcipala absent or minute. Anepisternal membrane with a tuft of pale setae dorsally. Katepisternal sulcus sharply defined, deep though sometimes wide, almost complete anteriorly; katepisternum below sulcus, in lateral view, longer than high. Male head like that of female, small and eye with small facets only (Figs 19-20). Terminalia as in Fig. 21. Female claw with a large basal thumblike projection (Fig. 13). Terminalia as in Fig. 22 . . . . Genus *Metacnephia* Crosskey ..... ***coloradensis*** n. sp.

— Calcipala present but usually small and bluntly pointed. Anepisternal membrane bare. Katepisternal sulcus wide and shallow, evanescent anteriorly; katepisternum below sulcus, in lateral view, about as long as high. Female claw with a small subbasal tooth or a large basal thumblike projection (Figs. 10, 13) . . . . Genus *Cnephia* Enderlein ..... **undetermined species**

14 Basal section of R setose dorsally (Figs. 4, 6) **15**

— Basal section of R bare dorsally (Fig. 5) **18**

15 Postnotum with recumbent, yellow setae. Pedisulcus short, deep and distinct, its depth about 1/2 or more the width of the segment; legs bicolored. Male with gonostylus bent near base at nearly a right angle; ventral plate of aedeagus compressed laterally with a somewhat keellike median lobe that is more than twice as long as broad, slender, and with widely divergent basal arms (Fig. 183). Female terminalia as in Fig. 184 (Figs. 44, 64, in Peterson 1981) . . . . Subgenus *Eusimulium* Roubaud ..... ***aureum*** Fries

— Postnotum bare, without appressed yellow setae. Pedisulcus variable; legs rather uniformly yellowish brown to black, not distinctly bicolored. Male with gonostylus straighter, not bent near base at nearly a right angle; ventral plate of aedeagus not keellike but broad and somewhat flattened dorsoventrally **16**

16 Male with gonostylus tapered to a pointed apex, with a small, apical spine, and with a slight but distinct concavity on outside margin of apical 1/2; ventral plate of aedeagus somewhat quadrate, shallowly concave on distal margin, basal arms slightly convergent (Fig. 221). Female terminalia as in Fig. 218. Pedisulcus long, shallow and indistinct, its depth less than 1/3 the width of the segment (Figs. 43, 45, in Stains and Knowlton 1943) . . . . Subgenus *Hellichiella* Rivosecchi and Cardinali ..... ***canonicola*** (Dyar and Shannon)

— Male with gonostylus broad apically, not pointed but with a flattened, triangular flange medially, and a small apical spine directed anteromedially (Figs. 250, 266) (Fig. 63, in Peterson 1981). Ventral plate not as above. Female with pedisulcus short and deep, its depth usually 1/2 or more the width of the segment (Figs. 3, 6, in Peterson 1977) . . . . Subgenus *Nevermannia* Enderlein **17**

17 Male with distal margin of ventral plate of aedeagus, in ventral view, broad, shallow and nearly truncate, its ventral lip about 1/2 the width of the body of the ventral plate (measured at junction of basal arms, along the proximal margin) (Fig. 266). Sclerite dorsal to aedeagus with anterior margin expanded laterally armlike (Fig. 63g, in Peterson 1981). Female with inner distal angle (corner) of each arm of genital fork produced as a short, slender, variably pointed process (Fig. 267) (Fig. 3, in Peterson 1977). Setae on central portion of scutum golden, contrasting with the paler setae on the anterior and lateral margins ..... ***vernum*** Macquart

— Male with distal margin of ventral plate of aedeagus, in ventral view, concave, with a small lip that projects into this cavity but not beyond; lip narrower, about 1/3 or less the width of the body of the ventral plate. With a vase shaped sclerite dorsal to aedeagus (Fig. 250) (Fig. 77, in Davies et al. 1962). Female with inner distal angle (corner) of each arm of genital fork produced as a longer, broader process that is variably rounded to subtruncate (Fig. 251) (Fig. 38, in Davies et al. 1962). Setae on scutum uniformly pale yellow ..... ***pugetense*** (Dyar and Shannon)

18 Male with gonostylus broad, flattened, and with sinuous lateral margins; ventral plate of aedeagus broad, with a strong, mediodistal projection that may be 1/4 to 1/3 as long as gonostylus (Fig. 232) (Fig. 65, in Peterson 1981). Female with hypogynial valve elongate, usually reaching or extended slightly beyond anterior margin of cercus; anal lobe extended well below cercus, but scarcely produced posteriorly and without a ventral notch in profile (Fig. 233) (Fig. 45, in Peterson 1981) . . . . Subgenus *Hemicnetha* Enderlein ..... ***virgatum*** Coquillett

— Male with gonostylus variable in width but not unusually broad, and with lateral margins more regular or not strikingly sinuous; ventral plate of aedeagus without a strong mediodistal projection. Female with hypogynial valve short, rarely reaching anterior margin of cercus; anal lobe variable but often with a ventral notch in profile **19**

19 Male with gonostylus shorter than gonocoxite, flattened, subquadrate with inner distal angle prolonged and bearing a single spinule (Fig. 283) (Fig. 62, in Peterson 1981); Female with anal lobe narrowly angulate ventrally, or attenuate and extended well below cercus (Fig. 284) (Fig. 42, in Peterson 1981) . . . . Subgenus *Psilopelmia* Enderlein **20**

— Male with gonostylus variable in length, more or less cylindrical, or if flattened, usually much longer than greatest width at base; number of apical spinules variable. Female with anal lobe, if extended well below cercus then more uniformly broadened and with a more broadly rounded ventral margin **22**

20 Male thoracic ground color paler and more yellowish to orange brown, nearly always with distinct yellow marks dorsally and anterolaterally, and notopleural ridges usually, but variably, yellow, black areas matte, at most faintly pruinose; thorax, viewed from in front, with 2 outwardly curved, bright grayish pruinose, submedian, triangular spots that originate at posterior edge of anterolateral yellow area of scutum and extend posteriorly about 1/2-3/4 distance to base of wing. Ventral plate of aedeagus, in ventral view, distinctly rectangular, with distal margin nearly straight to slightly curved. Arm of paramere with, at most, a few enlarged, basal spines, but these not conspicuously larger or better defined than apical spines (Fig. 283) (Fig. 62, in Peterson 1981). Female thorax bright yellowish orange with 7 alternating stripes; pale stripes pruinose, brownish stripes matte. Terminalia as in Fig. 284 (Fig. 42, in Peterson 1981) ..... ***bivittatum*** Malloch

— Male thoracic ground color darker brown to black; scutum, dorsally, distinctly grayish pruinose (evident even in alcohol preserved specimens), and submedian scutal spots, if present, much narrower and shorter. Ventral plate of aedeagus, in ventral view, subtriangular to subrectangular. Arm of paramere variable. Female thorax darker yellowish brown to black, densely grayish pruinose; without stripes (however, stripes often discernible in alcohol preserved specimens), or thorax with a single, median, usually narrow, reddish to brown stripe. Terminalia variable **21**

21 Male thorax black, with 2 short, submedian spots. Ventral plate of aedeagus, in ventral view, rather slender and subquadrate, or, depending on angle of view, subtriangular and tapered distally to a point. Arm of paramere with a series of poorly defined spines, basal 3-4 of which are shorter, stouter, and better defined (Fig. 315). Female scutum with a single, median, usually narrow, reddish to brown stripe, remainder of scutum rather uniformly brown to black with a dense grayish pruinosity (Fig. 309) ..... ***venator*** Dyar and Shannon

— Male thorax brown to black, densely grayish pruinose. Ventral plate of aedeagus, in ventral view, broad, subrectangular, distal margin nearly straight to broadly rounded. Arm of paramere with 6-8 larger and well defined basal spines and 8-12 smaller, weaker, poorly defined spines (Fig. 299). Female scutum more uniformly dark yellowish brown to black, without a distinct median stripe (stripes often discernible in alcohol preserved specimens), densely grayish pruinose and often with a faint greenish yellow hue (Fig. 296) ..... ***griseum*** Coquillett

22 Calcipala small, ending well before pedisulcus (Fig. 11) Male thorax velvety black, with 2 submedian stripes of varying length on scutum; gonostylus short, stout, somewhat flattened, subconical to subquadrate, with 2-5 apical spinules; ventral plate of aedeagus, in ventral view, broadly triangular, with short basal arms. Female black, with densely ashy gray pruinescence, with 5 dark stripes on scutum (Fig. 344) and with a distinct black and gray pattern on abdomen; anal lobe extended well below cercus, broadly triangular in shape (Fig. 333, 350) (Figs. 48, 67, in Peterson 1981) . . . . Subgenus *Psilozia* Enderlein **23**

— Calcipala large, distinct, ending near dorsal margin of pedisulcus (Fig. 13). Male variable in color, with or without 2 submedian stripes on scutum; gonostylus long, more or less cylindrical, with a variable number of spinules; ventral plate of aedeagus, in ventral view, variable in shape, but if somewhat triangular then narrower and with long basal arms. Female, if black and gray pruinose, with 0-3 stripes on scutum and without a distinct black and gray pattern on abdomen; anal lobe usually not extended well below cercus, but if somewhat extended then not broadly triangular **24**

23 Male with gonostylus subquadrate, apex as wide or wider than base, with an obtuse rounded angle between the lateral and apical margins, apical spinules small and set close together (Fig. 329); submedian white areas of scutum usually extended back as 2 distinct stripes to the prescutellar white area (Fig. 324). Female with arms of genital fork without external processes, but each with a large, pale, internal process rather closely approaching that of the other side; anal lobe more strongly tapered and pointed ventrally (Fig. 330) ..... ***argus*** Williston

— Male with gonostylus subtriangular, the apicolateral margin a continuous curve so that apex of gonostylus is narrower than base, apical spinules larger and set farther apart (Fig. 349); submedian pale areas of scutum fading out before reaching prescutellar white area (Fig. 343) (Fig. 67, in Peterson 1981). Female genital fork each with a somewhat darkened external process, and a smaller and paler internal process that is more distant from the one of the other side; anal lobe less strongly tapered and more broadly rounded ventrally (Fig. 350) (Fig. 48, in Peterson 1981) ..... ***vittatum*** Zetterstedt

24 Male scutum without anterolateral white or silvery spots; ventral plate of aedeagus broad, lamellate, with distal margin nearly truncate, and lacking marginal denticles (Fig. 169) (Fig. 68, in Peterson 1981). Female forecoxa dark; foretibia entirely brown to black, without a bright white patch anteriorly; claw with a large basal, thumblike projection (Fig. 13); anal lobe shortly acuminate ventrally (Fig. 170) (Fig. 23, 49, in Peterson 1981) .... Subgenus *Byssodon* Enderlein ..... ***meridionale*** Riley

— Male scutum usually with variably distinct anterolateral silvery or white spots, or with submedian stripes; ventral plate of aedeagus variable, if broad and lamellate then with a median notch and lip, and often with marginal denticles. Female foretibia usually with a bright white patch anteriorly; if foretibia entirely brown or black, then anal lobe variable but not acuminate ventrally, at most with a very short rounded point **25**

25 Male gonostylus long and slender, narrowest at about midlength, with a small, internal, setose basal lobe and a single apical spinule; ventral plate of aedeagus, in ventral view, with a rounded distal margin, a median notch, and a short ventral lip without marginal denticles (Fig. 202) (Fig. 69, in Peterson 1981). Female with tarsomeres of foreleg slender; claw with a small subbasal tooth (Fig. 200); scutum with 2 distinct stripes; outer surface of anal lobe mostly bare and polished; posterior and inner margins of hypogynial valve shallowly emarginate (Fig. 203) (Fig. 47, in Peterson 1981) .... Subgenus *Hearlea* Enderlein ..... ***canadense*** Hearle

— Male gonostylus variable, but if long then more uniformly widened; ventral plate of aedeagus, in ventral view, variable, but if somewhat rounded on distal margin then margins of ventral lip with denticles. Female with tarsomeres of foreleg variable but often noticeably widened and laterally flattened; claw variable; scutum patterned or unpatterned; anal lobe variable, but outer surface usually setose and not polished; hypogynial valves short, their posterior and inner margins nearly straight to rounded .... Subgenus *Simulium* Latreille **26**

26 Male **27**

— Female **36**

27 Male gonostylus with a stout spine, sclerotized lobe, or distinct tubercle at base internally (Figs. 438, 454, 470, 485) **28**

— Male gonostylus without a stout spine, sclerotized lobe, or distinct tubercle at base internally **31**

28 Base of gonostylus with a rounded lobe internally, bearing short spines (Fig. 485) (Fig. 70, in Peterson 1981) ..... ***tuberosum*** Lundström

— Base of gonostylus with a stout spine or horny projection internally **29**

29 Basal arms of ventral plate of aedeagus with short, lateral projections; apex of ventral plate hyaline, the sides set off by a notch, setose (Fig. 470) ..... ***piperi*** Dyar and Shannon

— Basal arms of ventral plate of aedeagus without lateral projections; if apex of ventral plate is smooth and pale it is long and narrow **30**

30 Ventral plate of aedeagus with a prolonged hyaline tip; base of gonostylus with a broad, flattened, sclerotized lobe internally (Fig. 438) ..... ***hunteri*** Malloch

— Ventral plate of aedeagus conical, without a prolonged hyaline tip; base of gonostylus with a large, posteriorly directed lobe internally (Fig. 454) ..... ***jacumbae*** Dyar and Shannon[2]

31 Ventral plate of aedeagus relatively broad, tooth-shaped, with dentate lateral margins that flare outward; in end view, ventral plate appearing somewhat trilobed (Fig. 499) (Fig. 89, in Davies et al. 1962) ..... ***venustum*** Say

— Ventral plate of aedeagus narrow, in the shape of an inverted Y, with a ventral process or keel although this may not be very prominent, dentate lateral margins somewhat compressed laterally, not flared outward **32**

32 Ventral keel of ventral plate of aedeagus strongly compressed laterally, deep, rather square in profile and forming an angle before apex of median portion, with at most a short, bare, ventroapical projection beyond dentate portion (Fig. 403) (Fig. 73, in Peterson 1981) ..... ***decorum*** Walker

[2]S. *jacumbae* appears twice in the key because we have seen females both with and without a small, subbasal tooth on one or more of the claws.

— Ventral keel of ventral plate of aedeagus less strongly compressed laterally, more shallow, not square in profile, the angle being at the apex and forming a conspicuous, bare, ventroapical projection beyond dentate portion **33**

33 Dentate lateral margins of ventral plate of aedeagus somewhat separated but turned inward toward each other concealing the central region; ventral keel, in profile, triangular in shape, its inner margin straight or nearly so; parameral hooks all about equal in length, not distinctly formed (Fig. 512) (Fig. 90, in Davies et al. 1962) ..... ***verecundum*** Stone and Jamnback

— Dentate lateral margins of ventral plate of aedeagus more strongly compressed laterally, not turned inward toward each other, ventral keel, in profile, more ovate, the inner margin variably concave; parameral hooks gradually lengthened toward center, or a few large ones intermingled with much smaller ones, all more distinctly formed **34**

34 Posteroventral angle of ventral plate of aedeagus forming a distinct bare projection beyond dentate portion; parameral hooks gradually lengthened toward the center (Fig. 383)(Fig. 87, in Davies et al. 1962) ..... ***corbis*** Twinn

— Posteroventral angle of ventral plate of aedeagus scarcely produced beyond dentate portion; parameral hooks consist of a few large ones intermingled with much smaller ones **35**

35 Posteroventral angle of ventral plate of aedeagus more pointed; base of keel ventrally often with a short spine (Fig. 365); legs with extensive darkened areas, especially on femora ..... ***arcticum*** Malloch

— Posteroventral angle of ventral plate of aedeagus broader, more truncate; base of keel ventrally never with a spine (Fig. 420); legs extensively yellow, femora without or with only scarcely darkened areas ..... ***defoliarti*** Stone and Peterson

36 Claw simple, without a small, subbasal tooth (Fig. 12) **37**

— Claw with a small, subbasal tooth that is sometimes difficult to see (Figs. 363, 382, 418) **41**

37 Frons and terminal abdominal tergites distinctly pruinose; anal lobe large, subquadrate, narrow dorsally, greatly broadened ventrally, anteroventral margin rounded, posteroventral margin slightly produced under cercus (Fig. 404) (Fig. 49, in Davies et al. 1962) ..... ***decorum*** Walker

— Frons and terminal abdominal tergites shining brown or black; anal lobe not as above **38**

38 Forecoxa brown to black. Subcosta bare on ventral surface. Terminalia as in Fig. 455 (also see couplet 43b for additional characters) ..... ***jacumbae*** Dyar and Shannon[2]

— Forecoxa yellow. Subcosta with a row of setae on ventral surface **39**

39 Fore tibia with, at most, a narrow, grayish white streak on anterior surface covering not more than 1/3 the width of the tibia; terminalia as in Fig. 486 (Fig. 47, in Davies et al. 1962); a small, dark species ..... ***tuberosum*** Lundström

— Fore tibia with a conspicuous, bright, yellowish white patch on anterior surface covering at least 1/2 the width of the tibia; terminalia, size and color variable **40**

40 Inner margin of hypogynial valves straight and slightly divergent distally; anterior margin of anal lobe not noticeably more sclerotized than rest of lobe (Fig. 500) (Fig. 50, in Davies et al. 1962) ..... ***venustum*** Say

— Inner margin of hypogynial valves concave, with an oval space between them; anterior margin of anal lobe noticeably more sclerotized than rest of lobe (Fig. 513) (Fig. 51, in Davies et al. 1962) ..... ***verecundum*** Stone and Jamnback

41 Scutum with 3 stripes, the median stripe faint, straight and slender, and varying in length; the lateral stripes more distinct, curved and usually wider, originating from or near anterior pollinose spots. Forecoxa variable in color **42**

— Scutum with a pair of somewhat triangular, pale pruinose spots anteriorly, but without distinct stripes; however, when viewed from certain angles, the scutum may show a pair of curved, dark, slender, faint lines originating from or near the anterior pruinose spots. Forecoxa always yellow **44**

42 Forecoxa yellow; claws long, slender, and rather straight, with a prominent subbasal tooth (Fig. 437). Proximal margin of cibarium with a prominent, median conical process covered with minute spinules (Fig. 434). Terminalia as in Fig. 439 ..... ***hunteri*** Malloch

— Forecoxa dark brown to black; claws short and curved, with a small, often difficult to see, subbasal tooth (sometimes females of *jacumbae* have one or more claws without a subbasal tooth). Proximal margin of cibarium with, at most, a tiny, median conical process, or none **43**

43 Hind margin of anal lobe entire, without a notch ventrally (Fig. 471). Anterior tarsomeres slender and cylindrical; the dark and yellow coloring of the mid- and hind basitarsi less distinct, the colors gradually fading into one another (Fig. 469). Setae on stem vein entirely, or predominantly dark. Proximal margin of cibarium smooth, without a conical process (Fig. 466) ..... ***piperi*** Dyar and Shannon

— Hind margin of anal lobe with a notch ventrally (Fig. 455). Anterior tarsomeres somewhat widened and flattened; mid- and hind basitarsi with more sharply differentiated yellow bases and blackened apices (Fig. 453). Setae on stem vein pale, occasionally intermingled with a few dark setae. Proximal margin of cibarium with a tiny conical process (Fig. 451) ..... ***jacumbae*** Dyar and Shannon[2]

44 Basal half of first flagellomere yellow, distal half brown; legs mostly yellow, femora scarcely or not at all brown distally (Fig. 419). Terminalia as in Fig. 421 ..... ***defoliarti*** Stone and Peterson[3]

— First flagellomere entirely dark brown to black; legs yellow but femora extensively darker (Fig. 364). Terminalia as in Fig. 366 (common species) ..... ***arcticum*** Malloch[3]

— Terminalia as in Fig. 384 (rare species) ..... ***corbis*** Twinn[3]

PUPAE[4]

1 Cocoon an irregular, shapeless, sleevelike structure, without a well-defined anterior margin, covering variable portions of pupa; terminal abdominal segment of pupa with 2 long, dorsal spines (Fig. 74, in Peterson 1981) **2**

— Cocoon usually well developed, variously shaped, and usually with a well-defined anterior margin, and usually covering most or all of pupa; terminal abdominal segment of pupa with, at most, 2 short, dorsal spines or none (Fig. 75, in Peterson 1981) **12**

2 Respiratory filaments variable in number but usually 30 or more, and arising from a rounded knob on a short petiole (Fig. 190, in Stone and Snoddy 1969) ..... genus ***Cnephia***

— Respiratory organ (gill) variable in shape; filaments variable in number but not arising from a rounded knob on a short petiole **3**

3 Respiratory organ (gill) consisting of 2 divergent, clublike structures, dorsal club slightly smaller and bearing 15-18 slender filaments, and ventral club with 20-29 slender filaments (Fig. 52) (Fig. 66, in Peterson 1970b). . . . *Prosimulium* . . . . Subgenus *Helodon* ..... ***onychodactylum***

— Respiratory organ (gill) not clublike, but consisting of a number of long, slender filaments arising from a short base **4**

4 Respiratory organ with 9 filaments branching 2+4+3 (dorsal, medial, ventral); filaments often as long or longer than pupa, arranged in a half-cuplike formation (Figs. 70, 71) (Fig. 67, in Peterson 1970b) . . . . Genus *Prosimulium* . . . . Subgenus *Parahelodon* ..... ***decemarticulatum***

— Respiratory organ with 12 or more filaments with various branching patterns but not as above **5**

5 Respiratory organ with 12 slender filaments arising from 2 main trunks which diverge from each other; the dorsal trunk dividing into 2 branches with 3 and 4 filaments respectively; the ventral trunk with 5 filaments (Fig. 159) (Fig. 28, in Currie 1986) . . . . Genus *Stegopterna* ..... ***mutata***

— Respiratory organ with 14 (rarely 12, 13, or 15) or more filaments with a different branching pattern . . . . Genus *Prosimulium*, in part **6**

6. Respiratory organ with 26 or fewer filaments; dorsum of thorax variable . . . . Subgenus *Prosimulium*, in part **7**

— Respiratory organ a dense cluster of about 80 to more than 100 short, slender filaments; filaments usually shorter than dorsum of thorax; dorsum of thorax rather smooth and shiny (Fig. 84) (Fig. 93, in Peterson 1970b) . . . . Subgenus *Prosimulium*, in part ..... ***exigens***

7 Respiratory organ with 14 (rarely 12, 13 or 15) filaments **8**

— Respiratory organ with 16 or more filaments **10**

8 Respiratory organ with 14 (rarely 12 or 13) filaments, arising from 3 swollen, primary trunks, ventral and lateral trunks less strongly divergent from each other than from dorsal trunk and each usually bearing 4 filaments, dorsal trunk usually bearing 6 filaments (Figs. 100-101) (Fig. 74, in Peterson 1970b) ..... ***frohnei***

— Respiratory organ with 14 (rarely 11, 12, 13, or 15) filaments arising from 3, short, non-swollen, primary trunks, dorsal and ventral trunks about equally divergent from median trunk; dorsal primary trunk with 6 filaments **9**

9 Ventromedial and mediolateral trunks of respiratory organ each with 4 sessile filaments (Fig. 36) . . . . Genus *Piezosimulium* ..... ***jeanninae***[5]

[3]These three species are extremely difficult to separate in the adult stage.

[4]The pupae of the unidentified species of *Cnephia, Metacnephia, Prosimulium* and *P. opleri* are unknown.

[5]The pupa of *Piezosimulium jeanninae* is not definitely known but is included here pro tem and provisionally separated from *frohnei* and *wui*, the other species of the area with 14 filaments.

— Ventrolateral and mediolateral trunks of respiratory organ each with 4 filaments on short to moderately long petioles . . . . Genus *Prosimulium* . . . . Subgenus *Prosimulium* ..... ***wui*** n. sp.

10 Respiratory organ with 20-26 filaments (av. 25), arising from 4 or 5 main groups (Fig. 10, in Peterson 1958) ..... ***flaviantennum***

— Respiratory organ with 16 filaments **11**

11 Dorsum of thorax strongly rugose; respiratory organ forming a slender, tightly grouped bundle (Figs. 132-133) (Figs. 78-79, in Peterson 1970b) ..... ***travisi***

— Dorsum of thorax not rugose, but with a superficial reticulate pattern and flattened granules (overall appearance more smooth); filaments of respiratory organ spread out, longer than wide, dorsal primary trunk usually longest (Fig. 117) (Fig. 83, in Peterson 1970b) ..... ***fulvum***

12 Cocoon rather loosely woven so that it is usually transparent, and with a distinct, anterodorsal collar whose ventral margin is set at an angle to the surface on which the cocoon is placed so that it appears vaguely boot-shaped; collar without festoons or windowlike openings (Fig. 24). Respiratory organ consisting of about 22-33 fine, pale white, filaments arising from 4 stouter trunks as follows: a longer tapered dorsal trunk, a short dorsolateral trunk, a short ventrolateral trunk, and a slightly longer ventral trunk (Fig. 23) (also see Fig. 24, in DeFoliart and Peterson 1960) . . . . Genus *Metacnephia* ..... ***coloradensis*** n. sp.

— Cocoon variable but often tightly woven, either with a variably developed anterodorsal collar, bearing festoons or windowlike openings or both, so that it is boot-shaped, or without a collar so that it is more slipper-shaped. Respiratory organ shape and number of filaments not as above Genus *Simulium* ... **13**

13 Respiratory organ consisting of a large, annulate club and 2 curved, basal projections, 1 dorsal and 1 ventral (Figs. 210-211) . . . . Subgenus *Hearlea* ..... ***canadense***

— Respiratory organ consisting of slender, branched or unbranched filaments **14**

14 Anterodorsal margin of cocoon with a long, median projection, base of this projection usually evident if projection is broken off (Fig. 274) (Fig. 29, in Peterson 1977) **15**

— Anterodorsal margin of cocoon without a long, median projection, but a short, convex protrusion or thickening may be present (Fig. 220) (Fig. 30, in Peterson 1977) **17**

15 Respiratory organ with 4 filaments in 2 distinctly petiolate pairs (Fig. 273). Dorsum of thorax clothed with only of few pale trichomes (Fig. 29, in Peterson 1977) . . . . Subgenus *Nevermannia*, in part ..... ***vernum***

— Respiratory organ with about 9-25 filaments, branching pattern variable. Dorsum of thorax rather heavily clothed with dark, unbranched trichomes (Figs. 39, 140, in Currie 1986) . . . . Subgenus *Simulium*, in part **16**

16 Respiratory organ with 9-13 filaments arising from base in 4 main groups, dorsal branch usually with 3 filaments and strongly divergent from other 3 groups (Fig. 477) (Figs. 39, 140, in Currie 1986) ..... ***piperi***

— Respiratory organ with 21-25 filaments arising from base in 3-4 groups that diverge more equally from each other (Figs. 461-462) ..... ***jacumbae***

17 Cocoon boot-shaped, with a prominent but variably elongate collar set at a distinct angle to the surface on which the cocoon is placed (Figs. 241, 373) (Figs. 41-43, in Currie 1986) **18**

— Cocoon slipper-shaped, without a distinct raised collar set at an angle to the surface on which the cocoon is placed, and without the sides touching anteroventrally, or cocoon with the front produced as a narrow collar that is only raised a short distance above the surface, and the sides narrowly touching or uniting anteroventrally (Figs. 410, 446) (Figs. 36-39, in Currie 1986) **21**

18 Respiratory organ with 8 closely clumped filaments in 2 distinct groups of 4 filaments each (Fig. 239); cocoon with a long collar that completely covers pupa; anterodorsal margin of cocoon with well-developed festoons, these sometimes broken but traces of them usually remain; a large species, 4-5 mm or more in length (Figs. 240-241) (Figs. 7, 9, in Stone 1948) . . . . Subgenus *Hemicnetha* ..... ***virgatum***

— Respiratory organ wiith 10-12 filaments variably arranged but not as above; cocoon with a variable collar but this often shorter so that pupa is situated close to opening of cocoon (Figs. 373, 390) (Fig. 16, in Stone and Peterson 1958) . . . . Subgenus *Simulium*, in part **19**

19 Respiratory organ with 10 filaments (Fig. 391) (Fig. 142, in Currie 1986) ..... ***corbis***

— Respiratory organ with 12 filaments **20**

20 Respiratory organ with filaments tapering from swollen bases, filaments spreading fanlike in a horizontal plane (Figs. 427-428, 430) (Figs. 14-16, in Stone and Peterson 1958) ..... ***defoliarti***

— Respiratory organ with slender filaments not arising from swollen bases, spreading fanlike in a vertical plane (Fig. 374) (Fig. 147, in Currie 1986) ..... ***arcticum***

21 Respiratory organ with 4 filaments **22**
— Respiratory organ with 6 or more filaments **24**
22 Respiratory organ, in lateral view, with all filaments closely clumped and parallel to each other, without any divergent filaments (Figs. 258-259) (Fig. 128, in Currie 1986). Dorsum of thorax with conspicuous raised granules .. Subgenus *Nevermannia*, in part ..... ***pugetense***
— Respiratory organ, in lateral view, with filaments more spread out and with 1 or more filaments divergent from others. Dorsum of thorax variable **23**
23 Dorsal respiratory filament strongly divergent at base from the other 3; dorsal pair of filaments on a short petiole, the ventral pair with almost no petiole (Fig. 191) (Fig.30, in Peterson 1977) Dorsum of thorax with raised granules .... Subgenus *Eusimulium* ..... ***aureum***
— Dorsal respiratory filament not strongly divergent from the other 3, however, the dorsal pair of filaments usually slightly divergent from the ventral pair and with a short petiole; ventral pair of filaments usually on a longer petiole (Figs. 219-220) (Fig. 130, in Currie 1986). Dorsum of thorax without conspicuous raised granules .... Subgenus *Hellichiella* ..... ***canonicola***
24 Respiratory organ with 6 filaments .... Subgenus *Simulium*, in part **25**
— Respiratory organ with 8 or more filaments **26**
25 Small species, about 2.5-3.0 mm long; respiratory organ relatively short, only about 1/2 length of pupa (Figs. 491-492) ..... ***tuberosum***[6]
— Larger species, about 3.5-4.0 mm or slightly more in length; respiratory organ (when not broken) as long as or longer than body of pupa (Figs. 505-506) (Fig. 134, in Currie 1986) ..... ***venustum***[6]
(Fig. 519-520) ..... ***verecundum***[6]
26 Respiratory organ with 8 filaments **27**
— Respiratory organ with 10 or more filaments **30**
27 Cocoon, especially anteriorly, loosely woven; filaments thickened, arising in 3 short petiolate pairs plus 2 singly (Figs. 410-411) (Fig. 61, in Stone and Jamnback 1955). Subgenus *Simulium*, in part ..... ***decorum***
— Cocoon tightly woven, with or without a thickened anterior rim; filaments slender, arising in 3 main groups branching (2+1) + (1+2) + 2 (dorsal, medial, ventral) .... Subgenus *Psilopelmia* **28**
28 Cocoon rather coarsely woven so that there often are distinct thicker and thinner areas, anterior margin only slightly thickened; in lateral view, anterolateral margin nearly straight but variably slanted anteromedially, anteroventral corners of cocoon variably produced inwardly and, at times, they meet or nearly so to produce a narrow, anteroventral collarlike lip or rim (Fig. 319) ..... ***venator***
— Cocoon more tightly and uniformly woven, without distinct thicker and thinner areas; anterior margin of cocoon variably but distinctly thickened; anterolateral margin of cocoon, in lateral view, variable **29**
29 Respiratory organ with long, slender, whitish filaments, the dorsal and medial groups on short petioles, the ventral group on a long petiole; anterior margin of cocoon with only a slightly thickened, narrow rim (Figs. 306-307) ..... ***griseum***[7]
— Respiratory organ with shorter and thicker filaments, branching fanlike near base of short petioles; anterior margin of cocoon broader and distinctly thickened (Figs. 290-291) (Fig. 139, in Currie 1986) ..... ***bivittatum***[7]
30 Respiratory organ with 10 filaments (Fig. 338) .... Subgenus *Psilozia*, in part, ... ***argus***
— Respiratory organ with more than 10 filaments **31**
31 Respiratory organ with 14-16 filaments (Fig. 358) (Fig. 28, in Peterson 1977) .... Subgenus *Psilozia*, in part ..... ***vittatum***
— Respiratory organ with more than 16 filaments 32
32 Respiratory organ with 22-26 filaments (Fig. 175) (Fig. 150, in Currie 1986) ..... Subgenus *Byssodon* ..... ***meridionale***
— Respiratory organ a dense tuft of 100 or more short, fine filaments; dorsum of thorax with numerous short trichomes (Figs. 445, 447) (Fig. 151, in Currie 1986) ..... Subgenus *Simulium*, in part ..... ***hunteri***

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[6]Pupae of these three species currently are virtually impossible to separate with any degree of certainty unless terminalia of developing adults are sufficiently developed for identification.

[7]Pupae of these two species currently are virtually impossible to separate with any degree of certainty unless terminalia of adults are sufficiently developed for identification.

LARVAE[8]

1 Postocciput nearly complete dorsally, enclosing cervical sclerites (Fig. 47). Basal 2 antennomeres pale, strongly contrasting with darkly pigmented distal antennomere. Median tooth of hypostoma distinctly trifid (Fig. 51). Anal papillae consisting of 3 simple fingerlike lobes (Fig. 17) (Figs. 80, 95, in Peterson 1981) . . . . . Genus *Prosimulium* **2**

— Postocciput with a distinct and usually wide gap dorsally, not completely enclosing cervical sclerites (Fig. 25). Basal 2 antennomeres, in most cases, at least partially pigmented, usually yellow to brown, not strongly contrasting in color with distal antennomere. Median tooth of hypostoma single (Figs. 27, 189) (Fig. 96, in Peterson 1981). Anal papillae consisting of 3 simple or compound lobes (Figs. 17-18) **9**

2 Lateral plate of proleg a narrow bar lying parallel to bases of apical hooks with, at most, a weak indication of a vertical portion (Figs. 127-128, in Peterson 1970b) **3**

— Lateral plate of proleg broader with vertical portion well developed (Fig. 126, in Peterson 1970b) . . . . . Subgenus *Prosimulium* **4**

3 Hypostomal cleft an inverted U-shape. Distal margin of hypostoma distinctly concave or dished, the outer lateral (corner) teeth higher than all other teeth; the median tooth subequal in height to sublateral (intermediate) teeth, its tines short, only about 1/3 as high as sublateral teeth (Figs. 66, 69). Anal sclerite subrectangular, anterodorsal and posteroventral arms, at most, only weakly developed (Figs. 98, 130, in Peterson 1970b; Fig. 24.16, in Peterson 1984) . . . . . Subgenus *Parahelodon* ..... ***decemarticulatum***

— Hypostomal cleft biarctate. Distal margin of hypostoma rather truncate, the median tooth as high or higher (usually higher) than highest lateral (corner) teeth and its tines about as high as sublateral (intermediate) teeth which, in turn, are all about equal in height (Figs. 48, 51). Anal sclerite X-shaped with both anterodorsal and posteroventral arms developed (Fig. 18) (Figs. 103, 136, in Peterson 1970b) Subgenus *Helodon* ..... ***onychodactylum***

4 Mandibular phragma extended ventrally to, and variably but often broadly connected to posterolateral margin of hypostoma. Antenna short, about 1/2- 3/4 as long as stalk of labral fan (Figs. 121-123, in Peterson 1970b) **5**

— Mandibular phragma not extended to, or almost to, posterolateral margin of hypostoma but separated from it by a wide gap. Length of antenna variable **6**

5 Head capsule with frontoclypeal apotome, distal to mandibular phragma, only slightly lighter brown than rest of apotome; head spots variable, usually indistinct, median spots usually darkened, lateral spots may be darkened or paler than median spots and paler than fulvous area surrounding them (Fig. 95). Posterior circlet with about 70-74 rows of hooks (Figs. 121, 144, in Peterson 1970b) ..... ***frohnei***

— Head capsule with frontoclypeal apotome yellow distal to mandibular phragma, remaining portions brown with margins blackened; head spots dark and distinct, darker than fulvous area surrounding them. Posterior circlet with about 76-80 rows of hooks ..... ***wui*** n. sp.

6 Outer lateral and sublateral teeth of hypostoma subequal in height, or some sublateral teeth highest so apical margin of hypostoma is somewhat convex or rounded; lateral tines of median tooth usually about as high as highest sublateral teeth. Hypostomal cleft broad and shallow with anterior margin rather truncate so overall appearance is rectangular. Head spots usually paler than darkened area surrounding them, this darkened area usually darker than rest of frontoclypeal apotome (Figs. 80, 83) (Figs. 120, 156, in Peterson 1970b) ..... ***exigens***

— Outer lateral teeth of hypostoma distinctly higher than sublateral teeth so apical margin of hypostoma is somewhat concave; length of lateral tines of median tooth variable. Hypostomal cleft broadly rectangular to an inverted U-shape. Head spots variable **7**

7 Hypostoma with median tooth distinctly lower than outer lateral teeth and usually lower than highest sublateral teeth. Hypostomal cleft broadly rectangular, nearly twice as wide as deep. Head capsule dark reddish brown, with a pale U-shaped area posteromedially behind posteromedian head spot. Labral fan with 28-34 primary rays. Posterior circlet with 10-12 hooks per row in about 78 rows (Figs. 5-9, in Peterson 1958) ..... ***flaviantennum***

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[8] The larvae of the unidentified species of *Cnephia, Metacnephia, Prosimulium, P. opleri* and *Piezosimulium jeanninae* are unknown. The form and number of filaments in the fully developed respiratory histoblasts of final instar larvae often provide useful supplementary characters for the identification of some species. This character is not used in the larval key but is illustrated for some species; the form of the respiratory organ and number of filaments can be found in the pupal key.

— Hypostoma with median tooth slightly shorter or slightly longer than outer lateral teeth, and distinctly longer than highest sublateral teeth. Hypostomal cleft an inverted U-shape. Head capsule variable in color but with a head spot pattern different than above. Number of primary rays in labral fan, and number of hooks per row and number of rows in posterior circlet variable **8**

8 Head capsule orange brown to dark brown, head spots variably distinct but usually darker than area surrounding them. Median tooth of hypostoma distinctly higher than outer lateral teeth (Figs. 127, 131). Labral fan with 26-34 (av. 30) primary rays. Posterior circlet with 8-10 hooks per row in 68-73 rows (Figs. 112, 143, in Peterson 1970b) ..... ***travisi***

— Head capsule light brownish orange to medium yellowish brown; head spots variable but usually indistinct, anteromedian spot often brownish and distinct, first and second anterolateral spots sometimes browned and distinct or all spots may be lighter than posterior part of frontoclypeal apotome or completely indistinct. Median and outer lateral teeth of hypostoma nearly equal in height or median tooth slightly but distinctly lower (Figs. 112, 116). Labral fan with 19-28 (av. 25) primary rays. Posterior circlet with 9-13 hooks per row in 80-88 rows (Figs. 113, 139, in Peterson 1970b) ..... ***fulvum***

9 Hypostoma either with uniformly small teeth, or with teeth clustered in 3 prominent groups (Figs 26-28, 158). Anterodorsal portion of frontoclypeal apotome, in lateral view, often strongly convex. Anal papillae consisting of 3 simple lobes (Fig. 17) (Figs. 91, 98, 100, in Peterson 1981) **10**

— Hypostoma with median tooth and outer lateral teeth of each side moderately large and subequal in height, and with 3 variably smaller but nearly equal sublateral teeth on each side. Anterodorsal portion of frontoclypeal apotome, in lateral view, not noticeably arched nor strongly convex. Anal papillae usually consisting of 3 compound lobes, but lobes simple in some species (Figs. 79, 90, 96, in Peterson 1981) . . . . . Genus *Simulium* **11**

10 Hypostomal cleft reaching or extended anteriorly slightly beyond base of hypostoma, moderately broad throughout and with apex rather truncate. Hypostomal teeth all very small, with outer lateral and sublateral teeth usually directed anteromedially (Figs. 25-28) (Fig. 86, in Peterson 1981) . . . . Genus *Metacnephia* ..... ***coloradensis*** n. sp.

— Hypostomal cleft shallow, usually extended anteriorly much less than 1/2 distance to base of hypostoma, acutely pointed and shaped much like an inverted V. Hypostomal teeth clustered in 3 prominent groups (Figs. 155, 158). Abdominal segment 8 with a single transverse, midventral bulge (Fig. 15) (Figs. 87, 94, 98, in Peterson 1981) . . . . Genus *Stegopterna* ..... ***mutata***

11 Abdomen, just anterior to posterior circlet, with 2 large ventral tubercles that are 1/3 to 1/2 depth of abdomen below their points of attachment (Fig. 16) **12**

— Abdomen without posteroventral tubercles (Fig. 14), or if present then these inconspicuous and reduced to 1/6 or less the depth of abdomen below their points of attachment (Figs. 94-95, in Currie 1986) . **18**

12 Abdominal segments 1-5 or 6 ringed with prominent subconical tubercles. Hypostomal cleft broad, about 3/4 as wide as deep, and extended to, or slightly beyond, base of hypostoma. Head spots pale, area surrounding them usually darkened (Fig. 171). Dorsum of abdomen, especially posteriorly, clothed with numerous short, dark setae (Figs. 96, 104, in Currie 1986) . . Subgenus *Byssodon* ..... ***meridionale***

— Abdominal segments 1-6 without prominent subconical tubercles. Hypostomal cleft relatively narrow and more shallow, not extended more than about 1/3 distance to hypostomal groove. Head spots and area surrounding them variably darkened. Abdomen without short, dark setae **13**

13 Hypostomal cleft usually a distinct inverted V-shape, but sometimes may be very shallow and broadly U-shaped or essentially nonexistent ...Subgenus *Simulium*, in part **14**

— Hypostomal cleft an inverted U-shape or somewhat quadrate **15**

14 Hypostomal cleft varying from a shallow V-shape, to a broad, very shallow U-shape, to essentially nonexistent; at most, extended about 1/4 distance to hypostomal groove; suboesophageal ganglion variable but often pale and difficult to see. Head spots darkened, sometimes not sharply defined, surrounding area faintly darkened (Figs. 472-473). Median antennomere paler than basal or distal antennomeres (Fig. 105, in Currie 1986) ..... ***piperi***

— Hypostomal cleft deeper and more distinctly V-shaped, extended about 1/3 distance to hypostomal groove; suboesophageal ganglion dark and distinct. Head spots darkened, rather discrete, surrounding area pale. Median antennomere darker, nearly concolorous with those on either side (Figs. 456-457) . ..... ***jacumbae***

15 Second antennomere subdivided into 4 irregular, sclerotized annuli alternating with hyaline membranous areas. Hypostomal cleft an inverted U-shape, extended about 1/3 distance to hypostomal groove, and about as wide as deep (Fig. 100, in Currie 1986) . . . . Subgenus *Hellichiella* ..... ***canonicola***

— Second antennomere not subdivided into alternating dark and hyaline annuli. Hypostomal cleft variable **16**

16 Hypostomal cleft widest at base, tapered anteriorly to a rounded apex, extended anteriorly about 1/3 the distance to base of hypostoma (Fig. 253). Anal papillae of 3 simple lobes although some specimens may have small, secondary lobules (Fig. 106, in Currie 1986) .....Subgenus *Nevermannia*, in part ..... ***pugetense***

— Hypostomal cleft with lateral margins parallel-sided, or widest at a point anterior to base. Anal papillae variable **17**

17 Hypostomal cleft small, anterior margin straight, or shallowly but broadly bowed posteriorly so that cleft is somewhat quadrate or rectangular in shape (Fig. 186). Anal papillae consisting of 3 simple lobes (Fig. 46, in Wood et al. 1963; Fig. 21, in Peterson 1977; Fig. 110, in Currie 1986) .....Subgenus *Eusimuliulm* .. .. ***aureum***

— Hypostomal cleft variable but anterior margin slightly bowed anteriorly so that cleft is more rounded overall (Fig. 269). Anal papillae consisting of 3 compound lobes (Fig. 45, in Wood et al. 1963; Fig. 20, in Peterson 1977; Fig. 109, in Currie 1986) ...Subgenus *Nevermannia*, in part ..... ***vernum***

18 Hypostomal cleft either relatively narrow and shallow and an inverted U-shape or apex rather truncate, or else deep and broadly bulbous in outline with apical margin always rounded; in any case length and width subequal. Anal papillae consisting of 3 simple lobes but sometimes a few small secondary lobules present (Fig. 17) **19**

— Hypostomal cleft an inverted V-shape, pointed apically; length usually greater than width. Anal papillae consisting of 3 compound lobes (Fig. 18) **23**

19 Hypostomal cleft relatively narrow and shallow, an inverted U-shape or apex rather truncate, margins usually distinct; head spots variably darkened but usually distinct and often surrounded by a distinct darker area . . . . Subgenus *Psilozia* **20**

— Hypostomal cleft broadly bulbous in outline, margins often faint and difficult to see; head spots pale, often obscure, if surrounded by a darker area this area pale and indistinct . . . . Subgenus *Psilopelmia* **21**

20 Antenna extended to near tip of stalk of labral fan. Hypostomal bridge and hypostoma nearly equal in length; hypostomal cleft longer, about 5/6 as long as both hypostomal bridge and hypostoma, its apical margin distinctly arched. Lateral plate of anterior proleg about as long as wide so it is nearly square, and extends posteriorly only about 3/4 length of segment. Inner subapical ridge of mandible with 2 longer, stouter, nearly equally sized serrations. Anteromedian and posteromedian head spots confluent or nearly so, area surrounding them sometimes variably darkened. Lobes of anal papillae with bases touching each other so spaces between them are V-shaped (Figs. 351-356) (Fig. 105. in Stone and Jamnback 1955; Fig. 117, in Currie 1986) ..... ***vittatum***

— Antenna distinctly extended beyond tip of stalk of labral fan. Hypostomal bridge shortly but distinctly longer than hypostoma; hypostomal cleft shorter, only about 1/2 as long as hypostomal bridge, its apical margin straighter so that cleft is more truncate. Lateral plate of anterior proleg subtriangular in shape, prolonged or pointed posterodorsally, and extends posteriorly full length of segment. Inner subapical ridge of mandible with about 5 shorter, serrations. Anteromedian and posteromedian head spots widely separated, often surrounded by a dark brown area whose lateral margins do not reach ecdysial line. Lobes of anal papillae separated basally so that space between them is more U-shaped (Figs. 331-336) ..... ***argus***

21 Head spots on frontoclypeal apotome pale brown but generally distinct, area surrounding them usually darkened so that overall pattern resembles that of *S. venustum* group; hypostomal bridge distinctly longer than hypostoma (more rarely subequal) (Figs. 285-286); labral fan with 30-40 primary rays. Posterior circlet with 70 or more rows of hooks (Fig. 111, in Currie 1986) ..... ***bivittatum***[9]

— Frontoclypeal apotome usually without distinct spots, if spots faintly visible, then hypostomal bridge either shorter or subequal in length to hypostoma; labral fan with a variable number of primary rays. Posterior circlet with a variable number of rows of hooks **22**

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[9] Larvae of this group of species are very difficult to separate reliably.

22 Hypostomal cleft extended about 2/5 distance to base of hypostoma (Fig. 302); labral fan with 30-36 primary rays. Posterior circlet with about 60 rows of hooks ..... ***griseum***[9]

— Hypostomal cleft extended over 1/2 distance to base of hypostoma (Fig. 318); labral fan with about 36 primary rays. Posterior circlet with 75-80 rows of hooks ..... ***venator***[9]

23 Abdomen gradually expanded posteriorly, widest on segments 7-8; rather shiny blackish species often tinged with orange dorsolaterally at least on posterior segments. Rather large species, mature larvae varying from about 8-15 mm in length **24**

— Abdomen more abruptly expanded so it is widest on segments 5-7 with 8 noticeably more slender; usually paler brownish to gray species, but if rather blackish then not tinged with orange dorsolaterally although this area may be whitish to pale yellowish. Smaller species, mature larvae rarely more than 9 mm in length .... Subgenus *Simulium*, in part **25**

24 Distal margin of hypostoma somewhat concave, with median and outer lateral teeth subequal in length. Hypostoma and hypostomal bridge nearly equal in length, and hypostomal cleft only slightly shorter (Fig. 205). Posterior circlet with about 88-105 rows of hooks with 12-14 hooks in longest rows. Anterodorsal arms of anal sclerite broad, rounded to slightly pointed apically, about 2/3 as long and about 10 times as wide as posteroventral arms. Anterior proleg with about 40 rows of hooks; lateral plate large, subquadrate, ventromedial margin straight to slightly rounded, tapered and prolonged posterodorsally and extended full length of segment. Abdomen largely blackish dorsally, paler and more whitish ventrally especially posteriorly; segment 6 with a broad, transverse black band dorsally contrasting with the more orange color on segments 7-8 (Fig. F, in Hearle 1929) .... Subgenus *Hearlea* ..... ***canadense***

— Distal margin of hypostoma distinctly convex, with median tooth longer than outer lateral teeth. Hypostoma distinctly (1/6) longer than hypostomal bridge, and hypostomal cleft about twice as deep as hypostomal bridge distal to it, and about 2/5 deeper than length of hypostoma (Figs. 235, 238). Posterior circlet with about 250-300 rows of hooks with 25-30 hooks in longest rows. Anterodorsal arms of anal sclerite slender and rather irregular, somewhat Y-shaped apically, just slightly more than 1/2 as long as posteroventral arms. Anterior proleg with about 60+ rows of hooks; lateral plate crescent shaped with ventromedial tip rounded and dorsolateral tip more pointed, extended full length of segment. Abdomen usually blackish in color but somewhat variable, often paler and not as extensively black as in preceding species, and without a distinct transverse black band on segment 6 .... Subgenus *Hemicnetha* ..... ***virgatum***

25 Hypostomal cleft a variable inverted V-shape, and often relatively narrow with nearly straight to slightly bowed sides, usually tapered to a variably narrow point but point not prolonged; hypostoma, hypostomal bridge and hypostomal cleft nearly equal in length. Head spots of frontoclypeal apotome not surrounded by a darkened area. Basal and distal antennomeres nearly equal in length and conspicuously shorter than middle antennomere, all 3 antennomeres rather uniformly brown except for ventral surface of middle antennomere which is paler (Figs. 440-441) (Fig. 116, in Currie 1986) ..... ***hunteri***

— Hypostomal cleft an inverted V-shape but wider and with distinctly bowed sides, strongly tapered to a narrow and sometimes prolonged point; hypostomal cleft usually deep so that hypostomal bridge is shorter than either hypostoma or hypostomal cleft. Head spots usually surrounded by a darkened area. Antenna variable **26**

26 Infuscation around head spots narrow, not extended beyond inner edge of anterolateral spots so that dorsal pattern is a narrow H-shape (Fig. 405) (Fig. 57, in Wood et al 1963) ..... ***decorum***

— Infuscation around head spots, if present, broader extended well beyond outer edge of anterolateral spots so that dorsal pattern is variable but not distinctly H-shaped **27**

27 Suboesophageal ganglion, visible through hypostomal cleft, distinctly blackened; hypostomal cleft usually shorter than in following species, its sides straighter, and apex without a narrow, nipplelike extension. Antenna long, nearly entire distal antennomere extended beyond apex of stalk of labral fan. Frontoclypeal apotome with a variably distinct subtriangular darkened area that extends laterally only as far as lateral spots, and anteriorly to about half way through anteromedian spots, anterior margin of this darkened area slightly concave (Figs. 487-488). Abdomen distinctly blackish (Fig. 54, in Wood et al., 1963; Fig. 97, in Currie 1986) ..... ***tuberosum***

— Suboesophageal ganglion pale, not darkened and usually not visible through hypostomal cleft; however, epidermis in this cleft may be darkened; hypostomal cleft variable in length, and lateral margins often somewhat sinuate and with a narrow, nipplelike apical extension. Antenna variable, but usually shorter and extended only slightly beyond apex of stalk of labral fan. Pattern on frontoclypeal apotome variable. Color of abdomen variable **28**

28 Hypostomal cleft with lateral margins slightly but usually distinctly sinuate, and with a narrow, nipplelike, apical extension; cleft extended almost to, or slightly beyond, hypostomal groove; epidermis in hypostomal cleft distinctly blackened. Antenna long, entire distal segment extended beyond tip of stalk of labral fan (Figs. 385-386) (Fig. 121, in Currie 1986) ..... ***corbis***[10]

— Hypostomal cleft with lateral margins straighter or bowed, but without a narrow, nipplelike, apical extension; depth of cleft variable; epidermis in hypostomal cleft pale, not blackened. Antenna shorter, tip extended at most, only slightly beyond apex of stalk of labral fan (Figs. 59-60, in Wood et al. 1963; Figs. 112, 120, in Currie 1986) **29**

29 Frontoclypeal apotome with at least slightly darkened head spots, the darkened area surrounding them, if present, usually slightly lighter than spots (Fig. 9, in Stone and Peterson 1958; Figs. 120, 124, in Currie 1986) **30**

— Frontoclypeal apotome with head spots pale, the darkened area surrounding them darker than spots (Figs. 59-60, in Wood *et al.* 1963; Fig. 112, in Currie 1986) **31**

30 Frontoclypeal apotome yellowish brown, with a rather indistinct darker pattern; antenna slightly darker, antennomere 2 with a subapical pale band, distal antennomere darker than others (Fig. 422) (Fig. 120, in Currie 1986) ..... ***defoliarti***[10]

— Frontoclypeal apotome more yellow anteriorly and darker posteriorly, with distinct, dark head spots, area surrounding spots darker and more strongly contrasting with anterior portion, this darkened area extended about 1/2 length of cephalic apotome; antenna paler, antennomere 2 without a subapical pale band (Fig. 367) (Fig. 124, in Currie 1986) ..... ***arcticum***[10]

31 Hypostomal cleft often bordered by a narrow darkened band (Fig. 502). Labral fan with fewer than 48 primary rays. Posterior circlet with over 70 rows of hooks. Lateral plate of anterior proleg heavily sclerotized, usually conspicuous (Fig. 59, in Wood et al. 1963 ..... ***venustum***

— Hypostomal cleft not bordered by a narrow darkened band. Labral fan with over 52 primary rays. Posterior circlet with about 66 rows of hooks. Lateral plate of anterior proleg lightly sclerotized, often difficult to see (Fig. 515) (Fig. 60, in Wood et al. 1963) ..... ***verecundum***

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[10] Larvae of this group of species are very difficult to separate reliably.

ANNOTATED LIST OF GENERA AND SPECIES

Cnephia unidentified species

There are three pinned adults of the genus *Cnephia* Enderlein in the CSU. One female taken by M.T. James and U. Lanhan, at Jefferson, Park County, Colorado, 1 Aug 1938, was identified by C.B. Philip as *Prosimulium pleurale* Malloch. A second female and one male, collected by M. T. James from Rabbit Ears Pass, Grand County-Jackson County, in late June, also appear to be the same species. The female and male terminalia do not match those of described species of *Cnephia* known to the authors. These specimens probably represent an undescribed species, but because we have only three specimens in poor condition we cannot provide a thorough description. Reared material will be needed to verify the species represented by these specimens. This species is included in the key as *Cnephia* unidentified species, to establish the presence of the genus in Colorado.

Colorado distribution.— 1,828-2,896 m. Grand Co.-Jackson Co., 18-26 Jun (A). Park Co., 1 Aug (A).

Metacnephia coloradensis Peterson and Kondratieff, n. sp.
Figs. 19-28

"Most likely . . . *Cnephia saileri*", Saether, 1970:105, fig. 28,a, respiratory organ (nec Stone, 1952).
Metacnephia sp. near *jeanae*, Bushnell et al. 1987:506.
Metacnephia new species, Peterson, 1989:327.

FEMALE. General body color dull black, lightly grayish pruinose. Length: body, 3.3-4.2 (av. 3.7) mm; wing, 3.3-4.1 (av. 3.8) mm.

Head and eye rather small; in lateral view occiput distinctly longer than eye. Frons moderately broad, at vertex about 2/3 as wide as at narrowest point, slightly more than 1/3 width of head, and slightly but distinctly wider than long; moderately covered with moderately long, erect, black pile, a few with yellowish reflections. Clypeus with length and width subequal; moderately covered with moderately long, erect and ventromedially directed, black setae some of which have yellowish reflections and pale yellowish tips. Occiput densely covered with long, black pile; postocular setae absent. Antenna entirely dark brownish black; flagellum with 9 flagellomeres; pedicel slightly but distinctly wider and longer than first flagellomere; fine pubescence pale yellow, longer setae on scape and pedicle black. Mandible poorly developed, weakly sclerotized, without serrations. Blade of maxilla slender, weakly sclerotized, without serrations or retrorse teeth. Palpus with third palpomere black, palpomeres 4-5 grayish yellow, palpomeres 3 and 4 subequal in length, palpomere 5 about twice as long as 3 and 4; with black setae some having yellowish reflections in some lights. Sensory vesicle small, situated near middle and about 1/6 length of its segment, its neck very short, arising anterodorsally and abruptly expanded into an enlarged round mouth. Median proximal space of cibarium deep, a broadly squared U-shape; dorsolateral arms relatively long and slender, apices heavily sclerotized.

Thorax rather uniformly brownish black to black, lightly grayish pruinose, scutellum contrastingly paler yellowish brown. Prescutum with tuft of moderately long, erect, pale yellow setae; postpronotum with moderately long, recumbent, pale yellow and black setae mixed; scutum moderately covered with short, recumbent yellow setae, these longer on posterior declivity; scutum, in posterior view, showing 2 faint, slender, submedian stripes that end before posterior declivity. Scutellum densely covered with long, yellow setae most of which have dark bases. Postnotum more densely grayish pruinose. Anepisternal membrane slightly paler brownish than rest of pleuron, with a tuft of short, yellow setae having dark bases and with some entirely dark setae; mesepimeral tuft rather large, consisting of moderately long, yellow setae having black bases. Precoxal bridge complete.

Wing membrane hyaline but with a grayish yellow cast; anterior veins yellowish brown, posterior veins more yellow; base of costa with mostly pale yellow setae; stem vein with pale yellow setae some of which have dark bases and with a few all dark setae; costa with a few longer yellow setae mixed with shorter black setae, rest of setae on veins black; fringe of calypter and anal lobe pale yellow. Base and anterior edge of stem of halter brown, rest of stem and knob pale yellow, with pale pile.

Legs (legs of wild caught females may be somewhat darker than that in following description): Coxae and trochanters brownish black to black, sometimes with small patches of yellow; femora largely brownish yellow but apices narrowly darker; tibiae brownish yellow with both ends darkened and with a narrow, dark dorsal stripe; basal tarsomeres of fore and midlegs brownish black but sometimes with bases narrowly yellowish, remaining tarsomeres brownish black; hind basitarsus and second tarsomere paler yellowish with darkened base, remaining hind tarsomeres brownish black; hind basitarsus nearly parallel sided, varying from about 5.1-7.0 times as long as broad. Claw evenly but not strongly curved from base, with only a moderately prominent basal tooth that is about 1/4 length of claw (from base of tooth to tip of claw), and well separated from rest of claw.

Abdomen generally brownish black, basal scale (tergite 1) sometimes with hind margin more grayish yellow, with a fringe of long, yellow setae that have dark bases; tergites dull black with narrow grayish yellow hind margins, and lightly grayish pruinose; moderately covered with short, yellow setae and a few dark setae posteriorly; pleural membrane paler grayish, that of segments 4-8 with anterior margins narrowly darker shiny brown, pleural membrane of segments 2-6 with

dorsal patches of moderately long, yellow setae; sternites rectangular, wider than long, sclerotized; sternite 1 tiny but distinct, vaguely and broadly W-shaped, bare, sternite 3 lightly sclerotized, all rather densely covered with erect, pale yellow and black setae.

Terminalia as in Fig. 22a-b. Anal lobe narrow dorsally, broadened ventrally, posteroventral margin not produced beneath cercus, ventral margin with a shallow but distinct notch so that it appears bilobed, moderately setose. Cercus subrectangular, about 1/4 higher than long, hind margin slightly rounded, tapered ventrally so that it is distinctly narrower ventrally than dorsally, moderately setose. Hypogynial valves rather short, extended only to about level of plate of genital fork, subtriangular, tip narrowly rounded posteriorly, medial margins narrowly sclerotized and divergent, lightly setose. Stem of genital fork long, heavily sclerotized, about 2.25 times longer than arms; arms short, moderately broad, divergent, area separating arms narrowly U-shaped, each arm expanded into a triangular plate with a short, pointed inner distal process, a longer outer distal process narrowly joined to epandrium, and with a short, somewhat rounded, sclerotized toothlike process on anterior margin. Spermatheca small, globular, heavily sclerotized, with a short, sclerotized neck, and with a faint, loosely crinkled pattern.

MALE. General body color dull black, lightly grayish pruinose. Length: body, 2.4 - 3.4 (av. 2.9) mm; wing, 2.4 - 3.24 (av. 3.1) mm.

Head relatively small with small, distinctly separated eyes (Figs. 19-20), in lateral view, with occiput subequal in length to eye, densely covered with long, black pile, sometimes pile with pale yellowish tips and sometimes with a few entirely yellow setae especially ventrally. Eye not divided into upper and lower sections but similar in size and shape to that of female and having only small facets; postocular setae absent. Frons relatively broad for male black flies, at vertex about 1/8 width of head, about 1/3 as wide as long, slightly narrower than at level of lower margin of eye at ocular triangle, and at middle of eye only about 1/5 width of eye; moderately covered with moderately long, black pile. Clypeus slightly wider than long; moderately covered with moderately long, black pile. Mandible weakly sclerotized, without serrations. Blade of maxilla weakly sclerotized but with short, erect setae along margins. Antenna relatively long; scape, pedicel and flagellomeres concolorous, dark brown to blackish brown; pedicle slightly but distinctly wider and longer than first flagellomere; longer setae and fine pubescence black.

Prescutum with a tuft of erect, pale yellow setae; postpronotum with pale yellow setae and some black or bicolored setae. Scutum with scattered, erect, yellow setae, these more numerous laterally and on posterior declivity, and with more numerous short, recumbent, yellow setae that appear black in some lights. Scutellum densely covered with long, yellow setae some of which may have dark bases. Postnotum more densely pruinose than rest of thorax. Anepisternal membrane more brownish than rest of pleuron, with a patch of yellowish setae dorsally; mesepimeral tuft relatively large, yellow. Precoxal bridge complete.

Wing membrane hyaline; anterior veins brown, posterior veins brownish yellow; base of costa with yellow setae mixed with some black setae; stem vein with mostly yellow setae but with some black setae, rest of setae black; small basal cell present and base of R setose as for genus; fringe of calypter and anal lobe pale yellow. Knob of halter yellow; stem brown, with pale yellow pile.

Legs rather long and slender, entirely black, grayish pruinose and largely covered with yellow setae but with scattered black setae especially on fore coxae; hind basitarsus cylindrical, not swollen, about 4.0-4.5 times as long as broad.

Abdomen black dorsally and ventrally, pleural membrane paler grayish yellow; basal scale with a fringe of long yellow setae some with black bases; tergites 2-6 matte black, remaining tergites densely pruinose; tergites moderately covered with short yellow setae, pleural membrane of segments 2-7 with long yellow setae and short black setae; tergite 10 small, subquadrate, margins somewhat irregular, slightly narrower posteriorly. Intracercal bridge lightly sclerotized. Sclerite just ventral to intracercal bridge (possibly sternite 10) more heavily sclerotized, bandlike, extended between apices of parameral arms. Sternites sclerotized, more shiny brown, anterior margin of sternite 1 distinctly concave with curved lateral margins, posterior margin convex; remaining sternites with anterior margins straight to slightly concave and posterior margins more con-

vex; sternite 1 bare, sternite 8 bare except for a few setae along hind margin, other sternites with moderately long setae that vary in color from mostly yellow to mostly black.

Terminalia as in Fig. 21a-e, heavily sclerotized. Gonocoxite subquadrate but with margins rounded, slightly but distinctly wider than long, sparsely setose on about distal 1/3. Gonostylus subequal in length to gonocoxite, slightly less than twice as long as its greatest width at base, broadest on about basal 1/4, inner lateral margin nearly straight then curved posterolaterally, outer lateral margin strongly concave distal to greatest width and tapers distally, apex pointed with a single, small apical spine; moderately setose. Ventral plate of aedeagus (= aedeagal guide (Wood 1991)) rather flat dorsoventrally; in ventral view, triangular, apex pointed, anterior margin between arms concave; in lateral view, with anterior (ventral face) nearly straight, without a noticeable ventral lip, densely setose; basal arms shorter than body, varying from slightly bowed to rather straight with tips convergent, and bearing a short, stout process laterally at junction with body; median sclerite of aedeagus long and slender, stem nearly 3 times as long as arm; aedeagal membrane bilobed with each lobe originating at apex of an arm, largely hyaline except for dorsal surface which bears a triangular series of minute, comblike sclerotizations that gives a lightly but noticeably sclerotized appearance that extends bandlike between apices of parameral arms. Paramere somewhat triangular, base widened, margins rather straight and tapered distally, apically with about 8-10 slender, mostly distinct, sclerotized spines with a few short, slender spines between larger spines.

PUPA. Length: body, 2.4-4.8 (av. 3.82) mm.; cocoon, 3.6-6.7 (av. 5.1) mm (length of both pupal body and cocoon rather variable). Respiratory organ (gill) (Fig. 23) short, each respiratory organ situated so it resembles the side of a cup, its filaments pale white, short, slender, with numerous narrow annulations, and may be sessile or have short petioles, sometimes filaments branching near their bases or near their tips; branching pattern is rather irregular but overall shape of each organ is rather uniform, filaments only about as long as dorsum of head and thorax combined; respiratory organ consisting of a short, rather broad rounded base, with a short, thickened anteroventral branch that gives rise to 2 closely placed secondary branches, a mediolateral branch, and a somewhat longer posterodorsal branch that also gives rise to 2 less closely placed secondary branches; main and secondary branches with very short stems or these sessile; filaments varying from about 30-57 arranged as follows: anteroventral branch with 4-8 filaments; anterolateral branch with 6-9 filaments; mediolateral branch with 4-17 filaments; posterolateral branch with 5-12 filaments; and posteroventral branch with 4-17 filaments. Head appearing rather smooth and shiny dorsally but frons, clypeus, antennal and palpal sheaths with scattered, minute, slightly raised granules, and with a few similar granules dorsally along hind margin of vertex; antenna of male extended to hind margin of head; antenna of female extended beyond hind margin of head by length of distal antennomere. Dorsum of thorax smooth and shiny, with a faint superficial reticulate pattern, without raised granules; dorsal trichomes long, simple, and slightly sinuous or curved near tip, each side of thorax usually with 3 middorsal, 2 more anterolateral and 1 more posterolateral, and 1 more ventral and posterior to base of respiratory organ. Chaetotaxy of each lateral half of abdominal tergites as follows: 1 with 1 short, submedian seta, 4 more lateral setae, and 1-2 tiny setae on slightly sclerotized bases in pleural membrane; tergite 2 with 6 short, stout setae near hind margin and 2-3 finer setae anterolaterally; tergites 3 and 4 with 4 anteriorly directed spines along their posterior margins, 1 just anterior to lateralmost of this series, and 3 situated on tiny, slightly sclerotized bases in pleural membrane; tergite 5 with 1 tiny, submedian seta and 5 similar setae laterally, 1 of which may be situated in pleural membrane; tergite 6 with 3-4 fine, posteriorly directed spinules laterally near anterior margin, and with 1 tiny sublateral seta along hind margin and sometimes with a similar seta more ventrally in pleural membrane; setation of tergites 7-8 similar to 6 but with more numerous short, fine, posteriorly directed spinules near anterior margin; tergite 9 without spinules but anterior margin with a row of striations; pleural membrane of segments 8-9 with 4 short, strongly curved, 2-3 branched hooks; caudal spines absent but with 2 tiny sclerotizations. Chaetotaxy of each lateral half of sternites as follows: sternite 3 with 4 short, stout setae, lateral

most seta well separated from other 3; sternite 4 with 4 small, slender, lateral hooks near hind margin, and with 2 more median setae near anterior margin; sternites 5 with 3 longer, rather slender, lateral hooks near hind margin, and with 2 more median setae near anterior margin; sternites 6-7 with 2 slightly larger hooks laterally, those of 8 more widely spaced; sternite 9 bare. Cocoon (Fig. 24) boot-shaped, densely woven, yellowish gray in color; distinctly longer than and completely enclosing pupa, including all or most of filaments; in lateral view, anterior collar of cocoon varying somewhat in its angle from the ventral margin but always an obtuse angle, anteroventral lip also variable but usually long and projected well in front of dorsomedial margin, about 2/5 as long as rest of cocoon, floor extended about 1/2 length of body of cocoon.

LARVA. Length 6.8-8.4 (av. 7.76) mm. Body color dark grayish brown, venter usually somewhat paler and more yellowish gray, intersegmental lines rather broad, slightly lighter and more yellowish than rest of abdomen. Head capsule (Figs. 25-26) rather uniformly blackish brown, frontoclypeal apotome paler and more yellowish between stalks of labral fans and then darker anteriorly; head spots rather obscure and often difficult to discern, in recently molted larvae head spots slightly darker than surrounding area, in older larvae head spots paler than surrounding area; anteromedian and posteromedian spots nearly confluent; anterolateral spots small, closely placed; posterolateral spots larger, faintly more distinct. Antenna slightly but noticeably longer than stalk of labral fan, basal antennomere with a rounded dark spot on dorsal surface of apical 1/2-2/3, basal portion and entire second antennomere transparent, apical antennomere dark brown like that of genus *Prosimulium*; proportions of segments rather variable but about 8:13:6 (basal to apical). Labral fan with 60-70 (av. 63) primary rays, each ray pectinate with rather uniformly long setaform processes. Hypostoma as in Figs. 26-28; strongly triangular in shape with slightly concave, sloping, lateral margins, apex only about 1/3 or less as wide as base posterolateral to basal hypostomal setae; distal margin slightly concave, medial tooth slightly longer than the 2-3 sublateral teeth of each side, outer lateral teeth rather broadly rounded and followed by 2 similar paralateral teeth and with 3-4 faint serrations on each side at about level of distalmost hypostomal setae; usually with 2 long and 2-3 shorter hypostomal setae on each side plus 1-2 pairs of small submedial setae near base. Hypostomal cleft deep, extended to base of hypostoma, strongly tapered apically so that base is about 3 times as wide as at narrowest point. Mandible with 1 long, strong, apical tooth flanked by 2 small dorsal teeth and 1-2 small ventral teeth; with about 12 slender comb-teeth; inner subapical ridge with 2 tiny, pale serrations on a prominent rounded convexity. Maxillary palpus about 3.0-3.5 times as long as width at base. Lateral plate of proleg short, varying in shape from subtriangular to subquadrate, greatest length and width nearly equal, heavily sclerotized, extended only about 1/4 length of apical segment; apical circlet with about 8 hooks in about 38-40 rows. Anal setulae minute, sparse, widely scattered dorsally; anal papillae relatively long, simple, each curved anteriorly and evenly divergent from each other. Anterodorsal arm of anal sclerite about 2/3 as long as posteroventral arm, wider and somewhat irregular in shape; posteroventral arm more slender and more heavily sclerotized; abdomen with a small, slender, barlike sclerotization, of varying intensity, on each side ventral to tips of posteroventral arms. Posterior circlet of hooks consisting of about 17 hooks in about 130 rows.

Type material.—Holotype male, with associated pupal pelt (preserved in alcohol); North Boulder Creek between Green Lakes 5 and 4, elev. 3,566 m [= 11,700'], Boulder Co., Colorado, 23 Aug 1988, B.V. Peterson and S.K. Wu; USNM.

Paratypes.—466 males, 296 females, 533 pupae, 1,095 larvae, same data as holotype. 17 males, 7 females (reared), plus 10 males, 1 female, 9 pupae, North Boulder Creek below Green Lake 3, Boulder Co., Colorado, 14 Aug 1990, Kondratieff, Harris and Painter; 5 males, 2 females (reared), plus 30 males, 5 females, 2 pupae, same data except below Green Lake 2; 1 male, 4 females (reared), 3 pupae, 95 larvae, same data except below Green Lake 4, 17 Aug 1990, B.C. Kondratieff and M. Harris; 1 male, 2 females (reared), plus 5 males, 67 females, 17 pupae, 1 larva, same data except below Green Lake 5, 25 Sep 1990, M. Harris and R. Durfee.

Additional nonparatype material examined includes: 257 larvae, North Boulder Creek surber sample between Green Lakes 4-5, Boulder Co., Colorado, 11 Sep 1981, J. Bushnell (code 1); 554

pupae, same data except (code 2); 1 female from pupa, same data except (code 3); 1 male, 2 females (poor condition), same data except (code 12); 1 female (poor condition), same data except (code 14); 2 males (poor condition), same data except surber sample at outlet of Green Lake 5 (code 16). 1 female, 77 pupae and empty pupal pelts, North Boulder Creek between Green Lakes 2 and 1, elevation 3,505 m (=11,500'), Boulder Co., Colorado, 11 Sep 1987, B.V. Peterson.

Etymology.—The epithet for this taxon is derived from the name of the state of Colorado.

Remarks.—*Metacnephia coloradensis* shows some intraspecific variability especially in the pupal stage and to a lesser extent in the larval stage. There is some differential in pupal size, shape of the cocoon, and shape of the respiratory organ, and in the larval stage the head capsule varies somewhat in intensity of coloration. Those larvae that have darker head capsules have paler head spots, and those that have lighter head capsules have slightly darker head spots, which, of course, can be a reflection of the recency of molting. The available pupae show considerable variation in the shape and number of filaments of the pupal respiratory organ. Typically, each respiratory organ has a longer anterior branch, a slightly shorter posterior branch that is quite similar to the anterior one, plus two mediolateral branches that are either sessile or have short petioles and a highly variable branching pattern. There seems to be about three different forms of respiratory organs, the typical one above, one very similar but with longer, more slender branches with considerably more numerous filaments, and one that is basically similar but all of the main four branches are short and stubby giving the respiratory organ a much more compact appearance. The filament numbers vary from 30 (the last type), to 35 (the more typical form), to 45+ for the longer, more slender form which may be distinctly longer than the other two. There is the possibly that these various forms represent three separate species. However, the male and female genitalia are identical from each type pupa and do not support this possibility. We consider these variations to fall within the normal range that might be expected due to crowding on the available attachment sites and to the severe environmental conditions under which the species lives. Despite these variations, *M. coloradensis* can be distinguished from all other species by the small femalelike head of the male with its small eyes having only small facets, and the shape of the gonostylus (Figs. 19-21). The female genital fork (sternite 9) is distinctive (Fig. 22), and the spermatheca is small, irregularly globular in shape and with a short, sclerotized neck connected to the spermathecal duct. The pupal case is similar to other Nearctic species but generally has a longer ventral liplike margin, and the respiratory organ, with its swollen main trunks bearing short but rather stout filaments, is distinctive, especially from other Nearctic species. The distal antennomere of the larva, like that of some other *Metacnephia* species, is entirely dark as in species of the genus *Prosimulium*, and the antenna differs from that of *Prosimulium* larvae only by the small darkened apical portion of the basal antennomere. We do not know the larvae of all the other species of *Metacnephia* and so cannot make any other meaningful comparisons between them and *coloradensis*.

The pupae of a number of species in the genus that have a respiratory organ with 30-57 filaments show considerable variability. This variability has lead some authors to describe several forms or subspecies of some species, e.g., *M. nigra* Rubtsov with three subspecies. *Metacnephia coloradensis* apparently belongs to the *pallipes* (Fries) group of species, but differs from all of them by the basic shape of the respiratory organ with many of its filaments branching near their tips so that many are very short. The respiratory organ is most similar to that of the Palearctic *M. ramificata* Rubtsov, the Nearctic *M. sommermanae* Stone, and *M. jeanae* DeFoliart and Peterson, but again differs in basic shape and filament branching pattern. Also, there are differences in the shape of the cocoon especially in the angle of the collar and the length of its anteroventral liplike margin.

The specimens cited by Saether (1970) (as "most likely . . . *Cnephia saileri* Stone"), and Bushnell et al. (1987) (as *Metacnephia* species near *jeanae*) were also from North Boulder Creek. Peterson (1989) referred to this species as *Metacnephia* new species. The senior author and S.K. Wu collected many larvae, pupae, mating adults, and reared other adults. Most of the adults in the type series were collected during a mass emergence on August 23, 1988. In the late afternoon of a sunny but cool day the flies emerged from the water and most crawled onto nearby warm, dry, bare rocks,

but some crawled onto wet, moss covered rocks. The flies immediately congregated in masses of a few to several hundred flies for mating. Many pairs were collected in copula. Our presence among the flies did not seem to deter them from mating, and we were able to collect many specimens using forceps and aspirators. When some flies were disturbed by our collecting efforts they only flew a few inches or feet from the mass of flies and immediately joined another mass of flies, again attempting to mate. Relatively few flies flew away from the stream and their flights were of short duration and not over 15-20 feet. We did not see any swarming males or aerial mating, and all such activity apparently took place on the ground near the stream. The small head and eyes of the male probably accounts for the lack of swarming and aerial mating. An examination of several of the mated females showed the presence of between 80 and 100 large eggs that were probably mature or nearly so. Due to the short summer season and the variable weather conditions at this high altitude, the eggs are probably ready for fertilization and the males capable of fertilizing them at the time of their emergence as indicated by the immediacy of mating after emergence. Elgmork and Saether (1970), and Bushnell et al. (1987) gave good descriptions of the area, and the former authors provided a photograph of the type locality of this species (which is also the type locality of *Piezosimulium jeanninae*). Peterson (1989) gave a short description of North Boulder Creek, and the reader is referred to these papers for more information on North Boulder Creek and its environs.

Colorado distribution.— 3,566-3,600 m. Boulder Co., 14 Aug-25 Sep (A, P, L).

Metacnephia unidentified species

We have two pinned specimens of what appears to be the same species of *Metacnephia* from: South Fork, Rio Grande County, 20 Jun 1972, elev. 8,000' [= 2,438 m], W.W. Wirth, malaise trap; and Beaver Creek, Rio Grande County, 21 Jun 1972, elev. 10,000'[= 3,048 m], W.W. Wirth, malaise trap. These specimens are similar to *M. sommermanae*, especially in the shape of the genital fork and hypogynial valves, but the serrated mandible and blade of the maxilla with retrorse teeth, and a much larger sensory vesicle of the third palpomere in these females separate them from *M. sommermanae*. The structure of the genital fork also distinguishes the species from all other described North American species. Formal description of this species will have to wait until additional material, especially of males, is available.

Piezosimulium jeanninae Peterson

Figs. 29-36

Piezosimulium jeanninae Peterson, 1989:318, Figs. 1-15 (male, female, pupa).

Type material.— Holotype male (removed from pupal skin; in fragmentary condition but with terminalia well preserved); North Boulder Creek, Boulder Co., Colorado, elev. 3,600 m, 11 Sep 1981, J. Bushnell (code 7); USNM.

This species was described from parts of two males and one female taken from pupal skins collected from a glacial melt stream at an elevation of about 3,600 m (Peterson 1989). The collection site is now more precisely known and we expect additional adults and the immatures to be found. While examining specimens from the type locality we discovered that the female paratype of *Piezosimulium jeanninae* and possibly the male head of *Piezosimulium jeanninae* are those of a new species, *Prosimulium wui*, described below. However, the form of the male terminalia of the holotype male of *Piezosimulium jeanninae* easily distinguishes it from *Prosimulium wui* and all other known species; the female of *Piezosimulium jeanninae* remains unknown. The male of *Piezosimulium jeanninae* has a sperm pump and a sclerotized, setose plate situated between the gonocoxites, features unknown in any other black fly, as well as a broad, M-shaped ventral plate (in ventral view), that is unlike that of *Prosimulium wui* or of any other species known to the authors. These unusual features of the male terminalia still validate the genus *Piezosimulium* and its only species *jeanninae*. Hopefully, future collections will allow description of more character states of this taxon. We provisionally accept the description and illustration of the pupal respiratory organ as valid.

Colorado distribution.—3,600 m. Boulder Co. (holotype male, known only from the type locality); 11 Sep (A).

Prosimulium (Helodon) onychodactylum
Dyar and Shannon [Complex]
Figs. 37-52

Prosimulium onychodactylum Dyar and Shannon, 1927:4, Figs. 10-11 (female).

Type material.— Holotype female (terminalia mounted on slide); Long's Peak trail, Colorado, timberline, elev. 11,200-11,300 ft. [= 3,413-3,444 m], 28 Aug, T.D.A. Cockerell; USNM, Type #28324.

Peterson (1959b, 1970b) provided a taxonomic history, full descriptions, illustrations, and a summary of the known biology of *P. onychodactylum*. More recently, Newman (1983) indicated *P. onychodactylum* to be a complex of 11 cytotypes, and Henderson (1986) added three more for a total of 14 forms. Of these cytotypes, '2a' and '10' are known from Colorado. The morphospecies has a wide distribution in the west, ranging from Alaska and the Yukon Territory south to California, Colorado and New Mexico. The immature stages live in clear, cold, moderately fast flowing water in small to moderately large streams. The larvae are commonly collected from rocks and sticks but usually do not occur in tightly clustered groups as some other *Prosimulium* species do. Dr. Pruess (pers. comm.) found cytospecies 10 abundant on vegetation, often at lateral outflows from beaver ponds. The larvae migrate to the underside of their substrate and pupate singly, or in small clusters, in the loose sand or rocky particles of the stream bottom. As a result, they are easy to overlook and often difficult to find. Consequently, reared adults are uncommon in most collections. The feeding habits of the female are unknown, but the well-developed mouthparts and the strong bifid claw suggest this species may feed on birds.

Colorado distribution.— 1,525-3,505 m. Archuleta Co., 4 Apr (L). Boulder Co., Jul- 28 Aug (A). Clear Creek Co., 18-21 Aug (L). Garfield Co., 7 Apr (L). Grand Co., 1 Aug-13 Sep (P, L). Gunnison Co., 20 Jun-30 Jul (L). Hinsdale Co., 11 Sep (A). Jackson Co., 30 Jul-5 Aug (L). Lake Co., 7 May (L). Larimer Co., 30 Jul-26 Aug (P, L). Mesa Co., 1 May (L). Rio Grande Co., 23 Jun (A). Summit Co., 21 Aug (L).

Prosimulium (Parahelodon) decemarticulatum
(Twinn) [Complex]
Figs. 53-71

Simulium (*Prosimulium*) *decemarticulatum* Twinn, 1936:110, Fig. 1, D, 1-3 (female, male, pupa).

Type material.— Holotype female (reared from pupa); Small stream near Carleton Place, Ontario, Canada, emerged from pupa, 10 May 1935, C.R. Twinn; CNC, Type #4122.

Lichtwardt and Williams (1988) reported trichomycete fungi from the gut of larvae of a species they listed as "*Prosimulium decemarticulatum* (Twinn) complex." Their specimens were larvae from the East River, downstream from Rock Creek, Gunnison Co., Colorado, collected 21 Jun 1985. If the original identification of these specimens is correct, this collection represents a new state record and a marked southward extension of the known range of this species. Previous records are from Alaska south to Alberta, east to Quebec and south to Michigan and New Hampshire. We have not collected this species in Colorado nor have we been able to locate, for verification, the specimens upon which this record was based. We have pupal specimens of a new species from northwestern New Mexico and northeastern Arizona, whose respiratory organ resembles that of *P. decemarticulatum* in general shape but which has 10-11 filaments that are arranged differently than the nine filaments of *P. decemarticulatum*. It is possible that Lichtwardt and Williams' specimens were of this undescribed species instead of *P. decemarticulatum*. Even though we are unable to resolve the problem here, the species is included in our keys for the sake of completeness and in the eventuality that this record might be authenticated.

Prosimulium (Prosimulium) exigens
Dyar and Shannon
Figs. 72-84

Prosimulium exigens Dyar and Shannon, 1927:10, figs, 3-4, 30-31 (female, male).

Type material.—Lectotype male (mounted whole on slide) (designated by Stone 1962); Moscow, Idaho, J.M. Aldrich; USNM, Type #28329.

This probably is the most common species of *Prosimulium* in the western states. It ranges from

British Columbia south to Colorado and Arizona. Peterson (1959b, 1970b) provided descriptions, illustrations, and biological notes for this species. The larvae are frequently found in slow to moderately fast flowing streams where the larvae and pupae congregate in large masses. Often, the pupae occur in layers that may be 5 or 6 deep, and sometimes the adults are unable to escape from the lower layers of such masses and die while only partially emerged. Sometimes the pupal mass gets coated with a varyingly deep layer of sediment that is often easy to mistake for a layer of gelatinous freshwater algae.

We have one male and five empty pupal pelts of what we are provisionally calling *P. exigens* from the same high altitude area (over 3,200 m) and the same glacial melt stream (North Boulder Creek) in which *Piezosimulium jeanninae*, *Prosimulium wui*, and *Metacnephia coloradensis* were found. The male terminalia of our specimen is nearly identical to that of typical *P. exigens*. On the other hand, the pupa has a cluster of many fine filaments in the pupal gill (respiratory organ), but the filaments are shorter, whiter, and much more closely clumped than that of typical *P. exigens*, *P. dicum* Dyar and Shannon, or *P. dicentum* Dyar and Shannon. The integument of the pupal thorax is somewhat intermediate to that of *P. exigens* and *P. dicum*. It is shiny but has a more roughened, distinct reticulate pattern than *P. exigens*, and is not granular like *P. dicum* nor rugose like *P. dicentum* (Peterson 1970a). Whether these minor differences are significant and the specimens represent a new species can be determined only after additional material of all stages is available for study. A number of attempts to obtain more specimens from the North Boulder Creek area have been unsuccessful. This area is extremely difficult to reach, and local weather conditions are unpredictable. Hopefully, continued prospecting in the area, will supply additional material.

Colorado distribution.— 1,830-3,566 m. Boulder Co., 14-23 Aug (A, P). Custer Co. (A). Gunnison Co., Jul-Aug (L). Hinsdale Co., 16-20 Jun (L).

Prosimulium (Prosimulium) flaviantennum (Stains and Knowlton)

Figs. 85-86

Simulium (Eusimulium) flaviantennus Stains and Knowlton, 1940:79, Figs. E, H (female).

Type material.— Holotype female (terminalia mounted on slide); Logan Canyon, Cache Co., Utah, 10 Jul 1938, D.E. Hardy and A.T. Hardy; USNM.

Not much is known about this attractive species. It is one of the few black fly species that has bright yellow antennae in both sexes, and is relatively easy to identify. Peterson (1958) redescribed the female, provided the first descriptions and illustrations of the remaining life history stages, and summarized its distribution and biology. The species is fairly widespread in the intermountain region but never seems to occur in very large numbers. The larvae are usually found in slow to moderately flowing, clear, snow-melt or spring-fed streams often with much emergent vegetation. The pupae occur on rocks and twigs, often in thick masses, and often are coated with fine silt from the stream bottom. Nothing is known about the feeding habits of the female.

Crosskey (1988) used the original spelling for this species in his world list; however, we follow Stone's (1965) corrected spelling of this species as used in the North American Diptera catalog.

Colorado distribution.— 1,555-2,135 m. Larimer Co., 31 May-5 Jul (A).

Prosimulium (Prosimulium) frohnei Sommerman

Figs. 87-101

Prosimulium frohnei Sommerman, 1958:196, Figs., 1, 4, 6-8, 12-15 (female, male, pupa, larva).

Type material.—Holotype female (in alcohol; reared from pupa); Small trickle parallel to the road at Eklutna Lake, elev. 875 ft. [= 266 m], 40 miles NE Anchorage, Alaska; pupa collected 26 Jul, adult emerged 31 Jul 1956, K.M. Sommerman; USNM.

This species ranges from Colorado (Carlsson 1966, 1968) and British Columbia north to Alaska. Even though widespread, it seems never to occur in large numbers, perhaps, for Colorado at least, due to the type of habitat in which it occurs. Larvae and pupae have most frequently been found in smaller, more sluggish streams, ranging from very tiny, spring-fed trickles to small snow-melt streams often less than 30 cm wide. The immature stages usually occur on the lower edges of rocks or twigs or on the undersides of twigs

and leaves. Larvae and pupae were collected from North Boulder Creek between Green Lake 5 and Green Lake 4, and also from a small, snow-melt stream, originating from the Mendenhall Snow Bank, a 'permanent' snow bank at 3,200 m (10,500'). The larvae and pupae were scattered on rocks and occurred singly or in small groups. The immatures were present along the length of the snow-melt stream but occurred only in small numbers. Basrur (1962) described the chromosomal complement of *P. frohnei*, and Peterson (1970b) provided descriptions, illustrations, and biological notes on this infrequently collected species. The report of *Prosimulium* species near *frohnei* in Colorado by Bushnell et al. (1987) refers to this species.

Colorado distribution.— 3,200-3,566 m. Boulder Co., 23 Aug (A, P, L). Larimer Co., 17-23 Jun (A, P, L).

Prosimulium (Prosimulium) fulvum
(Coquillett)
Figs. 102-117

Simulium fulvum Coquillett, 1902:96 (female, male).

Type material.— Holotype male (mounted whole on slide); Bear Paw Mountains, Montana, 3 Sep 1891, H.G Hubbard; USNM, Type #6182.

This large, colorful species is also widespread, ranging from Alaska south through the mountains well into Colorado. Descriptions, illustrations, and biological notes on *P. fulvum* appear in Peterson (1959b, 1970b), and Basrur (1962) described the chromosomal banding patterns. The immatures live in cold, fairly fast moving streams, varying from less than half a meter to several meters in width. In Colorado it has been found only in small numbers at any one site, perhaps because it is near the southern limit of its distribution. Females are not known to be major pests in Colorado even though Baker (1897) reported abundant females (as *Simulium ochraceum*) bothered horses at an altitude of 2,895 m. McAtee (1922) reported females feeding on horses and man in Alaska. This attractive species is one of the few predominately orange species in the genus *Prosimulium*, and is easily distinguished from all others in the genus except *P. fulvithorax* Shewell (see Peterson 1970b). Tiny rock and wood particles often are incorporated into the pupal cocoon.

Colorado distribution.— 2,895-3,518 m. Clear Creek Co., 21 Aug (P, L). Custer Co. (A). Grand Co., 7 Aug (A). Jackson Co., 7 Jul (A). Larimer Co., 29 Jul-14 Aug (A). Park Co., 21 Aug (P, L). Rio Grande Co., 21-25 Jun (A). Summit Co., 21 Aug (A, P).

Prosimulium (Prosimulium) opleri
Peterson and Kondratieff, n. sp.
Fig. 118

MALE (in alcohol). General body color dark brown. Length: body, 4.2 mm; wing, 4.1 mm.

Head and eye normal for genus. Frons and clypeus with erect, black pile with yellowish reflections. Occiput with long, black setae, some of which have yellowish reflections especially ventrally. Antenna brown, base of first flagellomere and pedicle more yellow; first flagellomere distinctly longer than pedicel which is slightly wider; fine pubescence and longer setae black. Palpus with palpomere 3 dark brown, 4-5 paler yellowish gray, with black pile; palpomere 5 slightly less than twice as long as palpomere 3, 3 about 1/6 longer than palpomere 4. Sensory vesicle proximally situated, slightly less than 1/2 as long as its segment, shaped much like an evaporating flask with a distinct, slender neck and a round mouth.

Thorax dark brown mottled with areas of lighter yellowish brown especially on prescutum, postpronotum, lateral margins of scutum, and pleuron; prescutum and postpronotum with longer pale yellow setae, scutum densely covered with moderately long, recumbent, yellow pile and longer black setae on posterior declivity. Scutellum yellow, densely covered with long, black setae some of which have yellowish reflections. Postnotum concolorous with scutum. Anepisternal membrane yellowish gray; mesepimeral tuft pale yellow.

Wing membrane hyaline; veins yellowish brown. Base of costa and stem vein with black setae with yellowish reflections; rest of setae on vein black; fringe of calypter and anal lobe pale yellow. Halter pale whitish, stem with anterior edge darkened and with fringe of pale yellow pile.

Legs yellowish brown to light brown, femora paler yellow, tarsi somewhat darker brown, segments with dark pile; hind basitarsus somewhat swollen with anterior margin straight and hind

margin more rounded, about 4 times as long as broad, second hind tarsomere distinctly swollen and conspicuously thicker than remaining tarsomeres.

Abdominal tergites largely black but mottled with yellow, their hind margins gray; basal scale with a fringe of long black setae whose tips may be paler brownish with yellowish reflections; tergites moderately covered with short, black setae; tergite 10 weakly developed, small, rectangular, slightly less than twice as long as broad; pleural membrane areas whitish gray; sternites longer than wide, dark brownish black, rather shiny, sternites 3-4 densely covered with very long, black setae, that of other sternites shorter and not so dense.

Terminalia as in Fig. 118, unusually small. Gonocoxite subtriangular, slightly longer than greatest width, outer surface entirely but sparsely covered with setae. Gonostylus rather long, slightly more than twice as long as greatest width at base; tapered distally to a short but rather oblique apical margin with 2 apical spines. Ventral plate of aedeagus, in ventral view, broad, broadest distal to junction with basal arms, roundedly tapered distally to a rather broad, truncately rounded apex; basal arm slender, heavily sclerotized, shorter than body, tip pointed, those of each side slightly divergent; in lateral and terminal views, with a short, broad ventral lip; median sclerite of aedeagus very short but longer than basal arms of ventral plate, stem wide with about 2 pairs of submedian longitudinal lines; arms hardly developed, but moderately sclerotized, strongly divergent, space between arms broadly and shallowly concave; aedeagal membrane with minute, spiculelike processes. Plate of paramere subrectangular, somewhat dished, only moderately sclerotized, arm short but longer than plate, rather straight, heavily sclerotized.

The female, pupa and larva are unknown.

Type material.— Holotype male (in alcohol), Lake Irene, Rocky Mountain National Park, elevation 3,231 m [= 10,600'], Grand County, Colorado, 3 Jul 1991, in an MVA trap, P.A. Opler; USNM.

Etymology.— This species is named in honor of the collector, Dr. Paul A. Opler, U.S. Fish and Wildlife Service, Fort Collins, Colorado.

Remarks.— This species is represented by a single male. Several attempts to collect additional material have failed. Because of its distinctive terminalia it is described to make this study as complete as possible. This unusual *Prosimulium* has a semi-glossy appearance because it seemingly lacks the usual heavy setal covering typical of most species of this genus; however, this condition might be due to the method of collection and the preservation of the specimen in alcohol. The terminalia are unusually small in comparison to the size of the specimen. The terminalia also are small in comparison with those of other species of the genus especially those taken at high altitudes. The ventral plate, in ventral view, resembles that of *P. shewelli* Peterson and DeFoliart, and *P. woodorum* Peterson, but is quite different in lateral view, and is sufficiently distinct in other characters that these three species should not be confused. Additional specimens will be needed before this species can be adequately treated.

Prosimulium (Prosimulium) travisi Stone

Figs.119-133

Prosimulium travisi Stone, 1952:76 (female, male, pupa).

Type material.— Holotype female (reared from pupa); 2nd stream, Ski Run Road, Anchorage, Alaska, 30 Sep 1948, K.M. Sommerman and L.H. Dover; USNM, Type #61188.

This is one of the most widespread species in the higher elevations of Colorado, and ranges northward to Alaska. Basrur (1962) described the salivary chromosomes, and Peterson (1970b) redescribed all stages of this species, provided illustrations, and brief biological notes. Little is known about this species in spite of its broad distribution. The larvae and distinctive pupae congregate in fairly large numbers in moderately fast flowing, clear, cold streams of varying widths and depths. The feeding habits of the females are unknown.

Colorado distribution.— 2,850-3,566 m. Boulder Co., 14 Aug -25 Sep (A, P, L). Clear Creek Co., 20-21 Aug (P, L). Larimer Co., 2 Apr-25 Aug (P, L). Park Co., 21 Aug (L). Rio Grande Co., 21-25 Jun (A).

Prosimulium (Prosimulium) wui Peterson and Kondratieff, n. sp.

Figs. 134-143

Prosimulium ursinum, Elgmork and Saether, 1970:19; Saether, 1970:105; Bushnell et al., 1987:506.

Prosimulium n. sp., Bushnell et al., 1987:506.

Piezosimulium jeanninae, Peterson, 1989:318, Figs. 1-2, 10-14, 15 (male head, female), in part.

Species near *Prosimulium neomacropyga*, Peterson, 1989:327.

FEMALE. General body color black, lightly grayish pruinose. Length: body, 2.6-3.7 (av. 3.1) mm; wing, 3.0-3.6 (av. 3.2) mm.

Head (Figs. 136-137) with small eyes and broad occiput, eye noticeably shorter than occiput. Frons very broad, at vertex varying from about 1/5-1/3 as wide as at narrowest point, distinctly wider than long, and conspicuously less than 1/2 width of head; moderately covered with moderately long, erect black setae some with pale tips or with yellowish reflections in some lights. Clypeus concolorous with frons; slightly longer than wide; moderately covered with moderately long, erect, black setae some with pale tips. Occiput densely covered with long, black setae some with pale tips or yellowish reflections in some lights; postocular setae absent. Antenna entirely brownish black; pedicel slightly wider than first flagellomere which is distinctly longer than pedicel; fine pubescence pale yellow, longer setae dark. Mandible weakly developed and often misshapened so that it is nearly truncate apically or only vaguely triangular, with about 10-15 minute, difficult to discern serrations. Blade of maxilla weakly developed, with about 1-6 minute, apical setulae and 2-3 more widely separated subapical setulae on outside margin. Palpus (Fig. 140) black, distal 2 segments slightly lighter and more grayish than palpomere 3; with black setae that have yellowish reflections; palpomere 5 about 1/4 longer than palpomere 3. Sensory vesicle about 1/4 as long as its segment, medially situated, its neck very short, arising anterodorsally, extended vertically and abruptly enlarged into a round mouth. Median proximal space of cibarium deep, broadly U-shaped; dorsolateral arms long, rather slender, moderately sclerotized.

Thorax black; prescutum and postpronotum with long, semi-erect to erect, black pile. Scutum lightly grayish pollinose especially on posterior declivity; scutum moderately covered with moderately long, erect black pile, apparently without short, recumbent setae. Scutellum sometimes paler brownish black; densely covered with long, black setae. Postnotum concolorous with scutum. Pleuron black; anepisternal membrane distinctly paler brownish gray; mesepimeral tuft black, some setae may have pale tips. Precoxal bridge rather broadly incomplete.

Wing membrane hyaline but with a pale but distinct brownish cast; veins pale brown. Stem vein with black pile sometimes mixed with a few yellowish setae; base of costa largely with black setae but mixed with a few pale yellow setae; rest of setae on veins black; fringe of calypter and anal lobe pale yellow. Halter largely pale yellowish white, stem faintly more brownish, with pale pile.

Legs: long and slender, brownish black with mostly black pile but with some scattered yellowish pile; hind basitarsus (Fig. 138) cylindrical, varying from 5.5-7.6 times as broad as long. Claw (Fig. 139) long and slender, evenly curved from base, with a very small, subbasal tooth that is difficult to see except under high power, this tooth lying close to base of claw.

Abdomen brownish black; basal scale (tergite 1), with a fringe of long dark pile which has pale reflections in some lights; tergites mottled with lighter brown areas and with grayish hind margins, moderately covered with short, semierect black setae; setae of each tergite continuous with setae of respective pleural membrane and sternite thereby forming a complete ring around each segment; tergite 9 produced posteromedially over tergite 10, its hind margin broadly rounded but more narrowed peaklike posteromedially; tergite 10 small, rectangular, wider than long; pleural membrane more brownish gray mottled with darker areas, and rather densely covered with moderately long, black setae; sternite 1 short, lightly sclerotized, somewhat crescent shaped with narrowed lateral margins, bare; sternite 2 lightly sclerotized, and with a small patch of black setae at each posterolateral corner; sternites 3-8 heavily sclerotized, shiny, brownish black mottled with yellowish areas, and rather densely covered with moderately long, black setae.

Terminalia as in Fig. 143. Anal lobe narrowed dorsally, broadened ventrally, posteroventral margin rounded, produced only slightly beneath cercus; moderately setose. Cercus subrectangular, about twice as broad as long, hind margin rounded. Hypogynial valves rather long, extended to about middle of anal lobe, medial margins rather broadly separated both basally and distally, lightly sclerotized for about 1/2 their lengths; each valve wide basally, inner margin slightly concave basally then straighter distally, outer margin broadly rounded basally, tapered distally to a rounded apex, moderately setose. Stem of genital fork (sternite 9)

long, slightly longer than arms, rather wide with irregular margins, heavily sclerotized, proximal end distinctly enlarged with distal margin pale medially; arm long, rather broad basally, tapered distally then expanded into a large, crescent-shaped terminal plate, rather narrowly attached to tergite 9. Spermatheca small, semi-globular, only moderately sclerotized, with a rather vague reticulate pattern.

MALE (teneral so all colors may be darker than indicated here). General body color brownish black. Length: body, 3.2-4.6 (av. 3.9) mm; wing, 3.0 mm.

Head (Figs. 134-135) with large upper facets of eye that gradually merge with smaller lower facets without a distinct line of demarcation between them. Frons and clypeus with long, erect black pile. Occiput with long, black setae dorsally that, in some lights, have yellowish reflections, and with some entirely yellow pile lateroventrally. Antenna yellowish brown to blackish brown; first flagellomere slightly longer than pedicel, but these subequal in width; fine pubescence pale yellow, longer setae black. Third palpomere concolorous with antenna, palpomeres 4 and 5 more yellowish brown, with black pile; palpomere 3 slightly longer than 4; palpomere 5 about twice as long as 4 and slightly less than twice as long as 3. Sensory vesicle about 1/4 as long as its segment, centrally situated, its neck short but distinct, enlarging to form a round mouth.

Thorax black, lightly grayish pruinose; prescutum and postpronotum with black pile, one specimen with entirely pale yellow pile. Scutum moderately covered with long, erect, black setae that have yellow reflections in some lights, and sparsely covered with short, recumbent, pale yellow setae. Scutellum yellowish brownish; densely covered with long, pale yellow setae some of which may have dark bases. Postnotum concolorus with scutum. Pleuron more brownish than scutum, lightly grayish pruinose; anepisternal membrane mottled with black but generally paler than rest of pleuron; mesepimeral tuft small, with fine, pale yellow setae and an occasional dark seta.

Wing membrane hyaline but with a definite yellowish brown tinge; veins yellowish brown; base of costa with pale yellow setae, stem vein with mixed pale yellow setae and some black setae; rest of setae black; fringe of calypter and anal lobe pale yellow. Halter brownish yellow, stem slightly paler, with pale yellow pile.

Legs entirely yellowish brown, central portions of femora and tibiae paler brown, coxae with long, black pile, longer pile of other segments pale yellow with a few black setae; hind basitarsus cylindrical, about 4 times as long as broad.

Abdomen mostly black; basal scale with a fringe of long black setae having yellowish reflections; tergites with narrow gray hind margins; tergite 7 with a small yellowish brown spot medially, tergites 8-9 more broadly yellowish brown medially; tergite 9 large, triangular, posteromedian angle narrowly rounded, and extends posteriorly over tergite 10 and cerci; tergites moderately covered with short, black setae that have yellowish reflections; setae of each tergite continuous with setae of respective pleural membrane and sternite forming a setose band completely around each segment; tergite 10 small, subquadrate, only slightly longer than broad; sternite 1 broader than long, smaller than others, bare; sternite 2 large, moderately sclerotized, with a small patch of about 4-6 setae at each posterolateral corner; remaining sternites rectangular, more heavily sclerotized, brownish black with pale grayish hind margins, moderately covered with black setae which may have yellowish reflections.

Terminalia as in Figs. 141-142. Hypandrium ventromedially with a broadened platelike expansion that has short, pointed lateral processes. Gonocoxite stout, subtriangular but with rounded margins, greatest length and greatest width nearly equal; moderately setose on about distal 1/2. Gonostylus stout, moderately long, about 1/4 longer than greatest width at base; apex sharply pointed with 1 small, apical spine and 1 smaller subapical spine. Ventral plate of aedeagus, in ventral view, stout, subtriangular in shape, distal margin rather broadly rounded, without a medial depression; basal arms straight, slightly shorter than body, together slightly longer than greatest width which is proximal to concave margin between basal arms; in lateral view, with a short, broadly rounded ventral lip. Median sclerite of aedeagus (= aedeagus) with a heavily sclerotized stem that is about twice as long as distal arms; arms less heavily sclerotized, divergent with a narrow U-shaped area between them. Paramere with a rather long, slender, heavily sclerotized rodlike arm that articulates with arm of ventral plate, and distally expands into a rather large,

rectangular plate that joins with gonocoxal apodeme.

PUPA. Length 3.9-5.1 (av. 4.5) mm. Respiratory organ a rather dark yellowish brown; 1.9-2.4 (av. 2.2) mm, about length of head and thorax in ventral view; consisting of a short, rather broad base, and usually with 14 filaments arranged in 3 groups, a ventrolateral group of 4 filaments (2+2), a mediolateral group of 4 filaments (2+2), and a dorsomedial group of 6 filaments (2+2+2), all pairs on short to moderately long petioles; sometimes dorsomedial group missing 1 or 2 filaments and mediolateral group missing 1 filament resulting in 11-12 filaments; filaments rather densely covered with minute setulaelike processes arranged in irregular rows or comblike series, and with numerous, narrow annulations. Head somewhat roughened with slightly raised granulations, with 2 trichomes along edge of frons behind antenna, 1 just medioventral to base of antenna, 1 sublateral near dorsal margin of clypeus, and 2 closely placed trichomes sublaterally near ventral margin of clypeus; antenna of male just short of reaching hind margin of head; antenna of female extended just slightly beyond hind margin of head. Dorsum of thorax rather smooth and shiny, and with a faint superficial reticulate pattern; trichomes long, sinuous and simple, each side of thorax usually with 2 just dorsal to base of respiratory organ, 3 more dorsomedial, and 1 posterolateral trichome just posterior to base of wing sheath. Chaetotaxy of each lateral half of abdominal tergites as follows: 1 with 2 short, sublateral setae near anterior margin, and 4 submedian setae; 2 with 6 short setae medially near hind margin and 1 similar more lateral seta; tergites 3 and 4 with 4 anteriorly directed spines along posterior margin, and 1 seta just anterior to lateralmost spine; tergites 5-9 each with a row of short, fine, posteriorly directed spinules near anterior margin, and usually with 2 setae near middle of lateral margin, those of 9 placed near each corner of tergite; caudal spines long and rather stout, each situated on a swollen convexity, rather strongly curved, tips slightly divergent, each with a long, stout seta at base anteriorly and posteriorly. Chaetotaxy of each lateral half of abdominal sternites as follows: Sternites 3-4 bare except for a single seta posterolaterally; sternites 5-7 each with 4 longer, rather slender hooks and respective pleural membrane with a single seta, lateral hooks of sternites 6-7 lying in pleural membrane; sternites 8-9 bare, their pleural membranes each with 4-6 setae. Cocoon a densely woven, shapeless sack that covers anywhere from entire pupa to all or most of abdomen.

LARVA. Length 6.7-10.1 (av. 8.28) mm. Body color pale grayish brown, slightly more yellowish ventrally; intersegmental lines narrow, whitish gray. Head capsule with frontoclypeal apotome, distal to mandibular phragma, yellow, remaining portions brown with margins blackened; head spots dark and distinct, darker than surrounding fulvous area, anteromedian and posteromedian spots narrowly separated, anterolateral spot 1 paler than anterolateral spot 2, posterolateral spot 1 pale yellowish or obscured, posterolateral spot 2 large, irregular, dark, often united with that of other side. Antenna short, extended only about 1/2 length of stalk of labral fan; proportions of segments (basal to apical) 10:25:20. Labral fan with about 28-32 primary rays. Hypostoma heavily sclerotized, distal margin strongly concave; median tooth strongly inclined, distinctly shorter than outer lateral teeth but higher than highest sublateral tooth, its tines nearly as high as highest sublateral tooth; sublateral teeth increasing in length outwardly from middle; outer lateral teeth strong and somewhat divergent from each other, outer lateral margin with 8-10 small, variably developed serrations, and with about 4 hypostomal setae on each side. Hypostomal cleft broadly U-shaped, moderately deep, slightly wider at base than at apex, often slightly shorter than hypostomal bridge and hypostoma, but sometimes all 3 subequal in length. Mandible with 4 stout, heavily sclerotized apical teeth and a tiny tooth next to and ventral to largest tooth, and with about 16 poorly developed comblike teeth; inner subapical ridge with 16-20 fine, irregular serrations. Mandibular phragma extended ventrally and variably but often broadly joined with posterolateral margin of hypostoma. Maxillary palpus slender, 3.0-3.5 times as long as width at base. Lateral plate of proleg short, slender, somewhat hatched-shaped, moderately sclerotized, extended about 1/3 length of apical segment; apical circlet with about 6 hooks in about 40 rows. Anal setulae present along lateral margin of each anterodorsal arm of anal sclerite and extended bandlike transversely between each arm; anal papillae simple, rather long and strongly curved, lateral papillae strongly diver-

gent but tips recurved inwardly toward each other. Anterodorsal arm of anal sclerite heavily sclerotized, slender but often with distal apex irregularly broadened, about twice as long as posteroventral arm; posteroventral arm slender, sharply pointed, less heavily and extensively sclerotized. Posterior circlet of hooks consisting of about 12 hooks in about 76-80 rows.

Type material.— Holotype male (with associated pupal pelt); North Boulder Creek between Green Lakes 5 and 4, Boulder Co., Colorado, elevation 3,566 m [= 11,700'], 23 Aug 1988, B.V. Peterson and S.K. Wu; USNM.

Paratypes.—2 males, 1 female, 117 pupae, 68 larvae, same data as type locality. 26 pupae, same data except 11 Sep 1981, J. Bushnell, Code 7. 3 pupae, same data except Code 8. 1 male, 4 females, 1 pupa, same data except below Green Lake 5, 25 Sep 1990, M. Harris and R. Durfee.

Additional nonparatype material examined includes: pupal fragments, same data as type locality except 11 Sep 1981, J. Bushnell, Code 7. 14 larvae, same data except Code 6. 5 pupae, same data except Code 8.

Etymology.—This species is named in honor of Dr. Shi-Kuei Wu, Curator of the Zoological Collections Museum, University of Colorado, Boulder, Colorado, who accompanied the senior author to the type locality and endured the pain and struggle of the arduous climb to reach it.

Remarks.—*Prosimulium wui* was misidentified by Elgmork and Saether (1970), Saether (1970), and Bushnell et al. (1987) as *Prosimulium ursinum* (Edwards). The latter authors also listed a new species of *Prosimulium* from the same area that is *P. wui*. Peterson (1989) referred to this species as an undescribed species of *Prosimulium* near *neomacropyga* Peterson. The eye structure, the shape of tergite 9, and the form of the male and female terminalia suffice to distinguish *P. wui* from *P. neomacropyga*, and from the related Palearctic members of the *P. macropyga* Lundström and *P. ursinum* groups of species. Also, see discussion under *Piezosimulium jeanninae* above.

We have three pupal specimens from the Bushnell collection (code 8) identified as *Prosimulium esselbaughi* Sommerman, that really are *P. wui*. We suspect that some of the specimens reported as *P. esselbaughi* by Bushnell et al. (1987), Elgmork and Saether (1970) and Saether (1970), may also be *P. wui*. However, we suspect that most of the material these authors reported as *P. esselbaughi* really is *P. travisi* Stone. Because we did not have access to many specimens used by these authors we cannot confirm our supposition.

OTHER SPECIES OF *PROSIMULIUM*

Bushnell et al. (1987) incorrectly included *Prosimulium hirtipes* Fries in their list of species from the Green Lakes Valley area of Colorado; *P. hirtipes* does not occur in North America.

We recently received a single male specimen from Roaring Fork River, mile 52 on Route 83, Pitkin County, CO., 13 Aug 1993, collected by S. Fitzgerald. Initially we thought this represented a second specimen of *P. opleri* because of the small size and general shape of the terminalia, but closer examination proved this to be an undescribed species. Because the specimen is not in very good condition we refrain from describing and naming it at this time.

Stegopterna mutata (Malloch) [Complex]

Figs. 144-159

Prosimulium mutatum Malloch, 1914:20, Fig. 18 (female).

Type material.— Holotype female; Glassboro, New Jersey, 28 Mar 1910, C.T. Greene; USNM, Type #15404.

We collected five females, several immature pupae, and a few immature larvae of this species from mountain areas of two counties in the state. According to Basrur and Rothfels (1959) and Madahar (1969) there are reproductively isolated triploid and diploid forms, as well as several other cytotypes, in the *Stegopterna mutata* complex; however which of these cytotypes our material represents is not known. The few immature larvae and pupae available were taken from a small, rocky stream flowing out of Green Lake 1 in the Boulder City watershed area, and were found in association with *Prosimulium travisi*, *Metacnephia coloradensis*, and *Simulium hunteri* Malloch. *Stegopterna mutata* s.l. ranges from Alaska south to California, Utah, east to Newfoundland and south to Alabama.

Colorado distribution.—2,952-3,505 m. Boulder Co., 14 Aug-11 Sep (A, P, L). Larimer Co., 2 Jul (A).

Simulium (Byssodon) meridionale Riley
Figs. 160-175

Simulium meridionale Riley, 1887:513; Fig. 6 (female) (the male, pupa and larva listed in the original description probably were misidentified and belong to other species (Stone and Snoddy 1969)).

Type material.—Holotype female (abdomen and part of hind leg mounted on slide); probably Lake View, Mississippi, 16 Mar 1886 (see discussion by Dyar and Shannon 1927, page 32); USNM, Type #773.

In Colorado this is typically a foothills-prairie species, inhabiting pastoral-type streams and rivers that are mostly clean, cool to moderately warm, and moderately fast flowing with abundant vegetation. The larvae and pupae can be numerous locally but the species as a whole, even though fairly widespread, seemingly does not occur in high densities. There are about four generations per year. The females can be serious pests of poultry (Swenk and Mussehl, 1928), and are known vectors of *Leucocytozoon smithi* to turkeys. The female is reputed to bite man (DeFoliart and Rao, 1965), and the authors have seen numerous females, sent for identification by various state extension agents, that apparently were severely annoying cattle and horses. We collected a series of adults along the Michigan River, Rt. 14, Jackson Co., 21 Jun 1992, among which was a mermithomorph intersex that had a female head, male legs, and ill-defined male and female terminalia. Anderson and Dicke (1960) and Anderson and DeFoliart (1961) provided additional biological data for *S. meridionale*. Stone and Snoddy (1969) provided figures of the various life history stages of this species (reproduced herein).

Colorado distribution.— 1,524-2,135 m. Boulder Co. (A). Jackson Co., 21 Jun (A). Larimer Co., (A). Weld Co., 2 Apr-29 Sep (A).

Simulium (Eusimulium) aureum Fries
[Complex]
Figs. 176-191

Simulia aurea Fries, 1824:16 (female, male).

Type material.— Cotypes? Females; type material was collected by Zetterstedt in Scania, Sweden, from Esperod and Bjornstorp; ZIUL.

True *S. (E.) aureum* apparently does not occur in North America. *Simulium (E.) pilosum* Knowlton and Rowe was described from Utah (Knowlton and Rowe 1934), and for a long time was considered a synonym of *S. aureum*. Crosskey (1988) resurrected the name *S. pilosum* for the western representative of the *S. aureum* complex. Although *pilosum* (?= *aureum* cytospecies B) might prove to be the correct name for the western states representative of the *aureum* complex, no one has thoroughly studied this group and it is conceivable that both the widespread *S. bracteatum* Coquillett and the more southern *S. donovani* Vargas (?= cytospecies G) may also be present in some areas of western North America including Colorado (in fact, K.P. Pruess recently informed us (in litt.) that he collected larvae of what were identified cytologically (by P.H. Adler) as *aureum* cytotype G (?= *donovani*)). Consequently, until a definitive study of the western North American representatives of this group has been published, we will continue to use the name *aureum* s.l. for this species complex.

Representatives of this complex are easily distinguished from all other species (if not from themselves) in the state (see key). Various authors (Davies et al. 1962; Wood et al. 1963; Peterson 1977, 1981; Merritt et al. 1978) have illustrated the immature and adult stages, but it has yet to be determined just which of these illustrations apply to which of the cytotypes of the group. *Simulium aureum* probably occurs statewide but in low numbers even though it might be abundant locally. The immature stages are largely confined to smaller, clean, pastoral-type streams with abundant emergent and trailing vegetation. Peterson (1959b) provides additional notes on the biology of this species.

Colorado distribution.— 1,220-2,440 m. Boulder Co., 18 May (A). Eagle Co., 12 Aug (A). Jackson Co., 5-19 Aug (A, L). Lake Co., 24 Jul (A). Larimer Co., 26 Jun-30 Sep (A). Mesa Co., 11-14 Aug (A). Rio Grande Co., 20 Jun (A). Teller Co., 9 Aug (L). Weld Co., 19 Jul-29 Sep (A).

Simulium (Hearlea) canadense Hearle
Figs. 192-211

Simulium virgatum canadensis Hearle, 1932:14 (female, male) (as a new race).

Type material.— Holotype male; Lanes Creek,

Kamloops, British Columbia, Canada, 6 Aug 1931, T.K. Moilliett and R.T. Turner; CNC, Type #3454.

Simulium canadense ranges from British Columbia southeast to South Dakota, and south to New Mexico and into Mexico. The male, female, and pupa are figured by Vargas and Díaz Nájera (1957), while the terminalia are figured by Hearle (1935) and Peterson (1981), the pupa by Hearle (1929, 1935), and the larva by Hall (1974). The immatures often occur in moderately large numbers, usually in clean, cool, moderately flowing type streams with emergent or trailing vegetation. The feeding habits of the female are unknown. One male and one female of *S. canadense*, along with a single female of *S. arcticum* Malloch, were taken on January 16, 1993, resting on snow along the margins of Trout Creek in Chaffee Co. This is an unusual occurrence for both species, especially in view of the time of the year and their presence on snow. We do not know why the adults would have emerged this early in the season unless the water temperature was such to allow full development of the pupa and adult. However, very little collecting has been done during the winter months and such occurrences may be more common than might be expected. Miscellaneous biological notes on this common but little known species can be found in Peterson (1956, 1959a, 1959b), Hall (1972), and Mohsen and Mulla (1982).

Colorado distribution.—1,525-2,440 m. Alamosa Co., 3 Apr (L). Archuleta Co., 4 Apr (L). Boulder Co., 9-11 Sep (A, P, L). Chaffee Co., 16 Jan-4 Sep (A, P, L). Douglas Co., 3 Apr (L). Eagle Co., 7 Apr (L). Garfield Co., 7 Apr (P, L). Huerfano Co., 3 Apr (L). Larimer Co., 2 Apr-6 Jul (A, P, L). Las Animas Co., 6 Jan (L). Pueblo Co., 30 Jan (L). Teller Co., 8 Aug (L).

Simulium (Hellichiella) canonicola (Dyar and Shannon) [Complex]

Figs. 212-221

Eusimulium canonicolum Dyar and Shannon, 1927:22, Fig. 40 (female).

Type material.— Holotype female (terminalia on slide); Yellowstone Canyon, Yellowstone Park, Wyoming, 3 Jul 1922, H.G. Dyar; USNM, Type #28337

This species is fairly widespread but has a sporadic distribution. It seemingly occurs in low numbers in pastoral type streams with a moderate flow of clean, cool to warm water, with ample emergent and trailing vegetation. Little is known of the feeding habits of the female, but the claw with the large subbasal tooth suggests it to be a bird feeder. Peterson (1959a) recorded one instance of feeding on man. Brief biological notes on this species are given by Peterson (1959a, b). The larva and pupa are figured by Currie (1986).

Stone (1965) emended the original spelling of this epithet to *canonicola*. Currie (1986) considered Stone's action an "unjustified emendation," and both he and Crosskey (1988) followed Dyar and Shannon's original spelling. However, Mr. George C. Steyskal, an authority on linguistic matters, said that this epithet requires the emended spelling given by Stone and we use that spelling here.

Colorado distribution.—1,525-3,480 m. Archuleta Co., 4 Apr (L). Boulder Co., 9-11 Sep (P, L). Clear Creek Co., 19 Aug (P). El Paso Co., 18 Aug (P). Grand Co., 19 Jun (A). Jackson Co., 18 Jul (A). La Plata Co., 17 Jul (A). Larimer Co., 2 Apr (L).

Simulium (Hemicnetha) virgatum Coquillett [Complex]

Figs. 222-241

Simulium virgatum Coquillett, 1902:97 (female, male).

Type material.— Holotype male (terminalia on slide); Las Vegas Hot Springs, New Mexico, 4 Aug, H.S. Barber; USNM, Type #6183.

This large, attractive species ranges from Mexico north to California in the west and to South Dakota in the east, and has been reported from Oregon and Washington. It occurs mainly in clear, moderate to large streams and rivers, often in the fastest flowing portions. The species has been reported as feeding on horses but not man (Stone 1948, Hall 1972). Hall (1972) and Reisen (1975) give some biological data on this species in California and Oklahoma respectively. Stone (1948) redescribed and illustrated the adult and pupal stages, and provided a taxonomic history of the species, and Hall (1974) keyed and illustrated the larva. A recent cytological study indicates this to be a complex of 4 cytospecies (Muhammad 1988). However, more recent collections in some of the same and other localities in Texas, and New Mexico suggest that Muhammad had

misidentified some of his collections and, in reality, had several morphologically identifiable species. *Simulium virgatum* and related species will be treated in greater detail in a forthcoming revisionary study by the senior author.

Colorado distribution.— 1,372 m. Catron Co., 26 Jul (A). Larimer Co., 27 Jun-28 Aug (A). Mesa Co., 11 Aug (A)

Simulium (Nevermannia) pugetense (Dyar and Shannon) [Complex]
Figs. 242-259

Eusimulium pugetense Dyar and Shannon, 1927:23; Figs. 121-123 (male).

Type material.— Holotype male (abdomen and terminalia mounted on slide); Seattle, Washington, C.V. Piper; USNM, Type #28338.

The immature stages of this moderately large species are usually found in small to medium sized streams and rivers with an abundance of emergent or trailing vegetation. They seem to be most common on vegetation but may occur on stones and twigs. The species reportedly overwinters either in the egg stage (Anderson and Dicke 1960) or larval stage (Sommerman et al. 1955; Davies et al. 1962), and has a single generation in cold, upland streams and a possible second generation in warmer stream areas (Currie 1986). Pupae appear in early spring and adults emerge as the streams warm up. Eggs presumably are laid in the spring and diapause during the summer months, hatching in the fall and slowly grow over the winter season. Newly emerged females contain immature eggs (Davies et al. 1962). The females probably feed on birds as suggested by their bifid claws (Shewell 1955) and strong mouthparts. Brief notes on this species were given by Lewis and Bennett (1973) in Newfoundland. This is the first record of *S. pugetense* from Colorado but it is not unexpected since the morphospecies ranges from Alaska, Alberta, Newfoundland and Maine, south to California, Utah, and West Virginia.

Colorado distribution.— 3,048 m. Grand Co., 21 Jun (A, P).

Simulium (Nevermannia) vernum Macquart [Complex]
Figs. 260-274

Simulium vernum Macquart, 1826:79 (page 23 in reprint version)(see pages 1532-33 in Coulson *et al.* 1965).

Type material.— Holotype female?; Northern France; type material lost (see Crosskey and Davies 1972, pages 255-257).

Under this epithet 12 cytotypes have been recognized, eight of which are seemingly good biological species (Brockhouse 1985). Brockhouse (1985) listed "Gothic" as the cytotype collected by D. Featherston in three localities in Gunnison Country, Colorado. This is one of only two collections of this species in Colorado that we are aware of, consequently we have no other information on the Colorado representatives of this species. Peterson (1977) described and illustrated all stages of this morphospecies from Iceland. In the latter locality, the immature stages were most frequently collected from warmer water streams of small to moderate size, both from rocks and trailing vegetation. The female has the claw of bird feeding species. Cupp and Gordon (1983) provide some biological data for the species in northeastern United States.

Colorado distribution.— 2,708-3,263 m. Gunnison Co., 21 June-30 Jul (L). Jackson Co., 17 Jul (A).

Simulium (Psilopelmia) bivittatum Malloch
Figs. 275-291

Simulium bivittatum Malloch, 1914:31, Fig. 7 (female).

Type material.— Holotype female; East Las Vegas, New Mexico, 1 Jun 1901, T.D.A. Cockerell; USNM, Type #15415.

This widespread species ranges from Alberta and Saskatchewan south to California and Mexico in the west, and in the east to South Dakota and Nebraska. The females of this small, attractive species are bright yellow to orange, and the males black with distinct patches of yellow laterally, and often posteriorly, on the thorax. Descriptions and figures of all life history stages of this species appear in a recent revision of the North American species of the subgenus Psilopelmia (Peterson 1993). The immature stages are common in clean, cool, relatively stable streams where they most frequently are found on trailing vegetation (Pruess

and Peterson 1987; Pruess 1989). They also have been collected by one of the authors from rocks in Utah, and from turbid waters in southern Alberta. Aspects of filter feeding by the larvae have been discussed by Braimah (1987a, b, c). We have numerous adults of both sexes collected in light traps set up by Wayne Kramer in pasture areas and near barns in eastern Colorado. The females are pests of horses and cattle throughout the low foothill and prairie areas of the state. There are reports of females biting horses (Knowlton 1935; Twinn 1938), and mixed populations of *S. bivittatum* and *S. griseum* biting horses, cattle and man (Fredeen 1981). Francy *et al.* (1988) mentioned the presence of this species among voucher specimens taken from a collection of species that formed part of a pool of several species that tested positive for Vesicular Stomatitis virus in Colorado. Kramer et al. (1990) also reported the presence of Vesicular Stomatitis New Jersey virus in females of *S. bivittatum* in eastern Utah and western Colorado. For additional information and literature on the biology of this species see Peterson (1993).

Colorado distribution.— 1,524-2,353 m. Adams Co., 1 Aug (A). Boulder Co., 9-23 Oct (A). Jackson Co., 19 Aug (A). Larimer Co., 24 May-1 Nov (A). Mesa Co., 13 Aug (A). Moffat Co., 24 Jul (L). Pueblo Co., 25 Jul (A). Teller Co., 2 Aug (L). Weld Co., 21 Mar-15 Oct (A).

Simulium (Psilopelmia) griseum Coquillett

Figs. 292-307

Simulium griseum Coquillett, 1898:69 (female, male).

Type material.— Holotype male (terminalia on slide); Colorado, C.F. Baker; USNM, Type #10381 (pin bears yellow, hand printed Pseudotype label).

This small species is often collected in combination with *S. bivittatum*, and has essentially the same seasonal and geographical distribution. However, it does not seem to be nearly as abundant as *S. bivittatum* in the more northern reaches of their distributions. The immature stages of the two species are similar and often difficult to identify. Dry, pinned adults are much easier to distinguish than alcohol preserved adults or the immature stages. Complete descriptions of all these stages by Peterson (1993) in his revision of the North American species of the subgenus *Psilopelmia*, should help eliminate some of the difficulties of identification so that more accurate biological studies can be conducted on these species. *Simulium griseum* frequently accompanied *S. bivittatum* in the light trap collections mentioned under the latter species, and nearly always were fewer in numbers of both sexes. This species also is a pest of horses (Jones et al. 1977), and to a lesser extent cattle and man. It often occurs in greatest abundance in the warmer, slower flowing waters of small irrigation ditches. Edmunds (1954) reported it to occur in large numbers on cement drop structures of irrigation systems in Nebraska.

Colorado distribution.— 1,219-1,800 m. Adams Co., 1 Aug (A). Boulder Co., 9 Oct (A). Crowley Co., 14-20 Aug (A). La Plata Co., 17 Jul (A). Larimer Co., 2 Jun-19 Sep (A). Mesa Co., 2 May-9 Oct (A, P). Montezuma Co., 2 May (A). Pueblo Co., 25 Jul (A). Weld Co., 21 Mar-15 Oct (A).

Simulium (Psilopelmia) venator
Dyar and Shannon

Figs. 308-319

Simulium venator Dyar and Shannon, 1927:36, Figs. 92-93 (male, female).

Type material.— Holotype female; Reno, Nevada; USNM, Type #28343.

There is one Colorado specimen of what we consider to be this species in the USNM collection. It is a slide mounted male from Fort Collins, 31 Aug 1943, M.A. Palmer, light trap. This is the only specimen of this species that we have seen from Colorado. However, this record is not surprising because *S. venator* is known from adjacent Utah and Wyoming. The species was treated in detail by Peterson (1993).

Colorado distribution.— 1,550 m. Larimer Co., 31 Aug (A).

Simulium (Psilozia) argus Williston

Figs. 320-338

Simulium argus Williston, 1893:253 (female).

Type material.— Holotype female; Argus Mountains, California, May, 1891; Ukal, Type #53.

The female of this species is very similar in general habitus to that of *S. vittatum* and *S. encisoi*

Vargas and Díaz Nájera. The males and larvae of these three species also are very similar but the pupae are readily distinguished by the number of filaments in the respiratory organ (gill), and the consistency of the cocoon. All three of these species are now undergoing revisionary study and will be treated in a future paper. Little biological information is available on *S. argus*. In Utah, larvae and pupae were collected from small rocks and trailing vegetation in streams and small rivers flowing through pasture land, and shaded by lombardy poplar and cottonwood trees. Anderson and Voskuil (1963) and Hall (1972) reported the female to be a pest of livestock and the cause of a reduction in milk production by dairy cows . However, it does not occur in the huge numbers that *S. vittatum* does and probably is relatively limited in its importance as a pest. The pupa was differentiated from that of *S. encisoi* and *S. vittatum* by Vargas and Díaz Nájera (1949), and Hall (1974) included the larva in his key to southern California species. Biological notes have been given by Hall (1972) and Mohsen and Mulla (1982). Our only specimens are from Mesa County, but Dr. Pruess (pers. comm.) found this species to be fairly common in Trout Creek above Manitou Lake, Teller County.

Colorado distribution.— 1,372 m. Mesa Co., 11 Aug (A).

Simulium (Psilozia) vittatum Zetterstedt
[complex]
Figs. 339-358

Simulia vittata Zetterstedt, 1838:803 (female).

Type material.— Lectotype female (abdomen in glycerine in microvial on the original pin) (designated by Peterson 1965); Greenland; ZIUL.

Peterson (1965) designated the only known female of the type series as the Lectotype, redescribed the specimen and illustrated its terminalia. It is now known that two cytotypes of this entity occur in Colorado, viz, IS-7 and IIIL-1. These cytospecies often are sympatric, but at the moment we are not able to reliably separate them morphologically. The complex is now under study with the hope that these entities can be separated by other than cytological means. *Simulium vittatum* is a severe pest of horses and to a lesser extent cattle. Francy et al. (1988) mentioned the presence of this species among voucher specimens taken from a collection of species that formed part of a pool of several species that tested positive for Vesicular Stomatitis virus in Colorado. Cupp et al. (1992) demonstrated that females of *S. vittatum* were competent vectors of the Camp Verde strain of this virus and provided the first confirmation of biological transmission of this arbovirus by a member of the Simuliidae. Cross et al. (1993) studied the response of mice hosts to the saliva of females of *S. vittatum*, and found that salivary gland extract contained a number of components that were recognized by IgC, IgM, and IgE antibodies in mouse antisera. Females also are pests of man causing annoyance by their persistent flying about the head and darting into the eyes, ears and nose. An extreme case of human annoyance was described by Peterson (1977). Probably more has been published on various aspects of the biology of this species than on any other North American species except *S. venustum*. The morphospecies has been reported all across North America and south into Mexico, north into Greenland, Iceland and the Faeroe Islands.

Colorado distribution.— 1,525-3,200 m. Adams Co., 25 April (A). Alamosa Co., 3 Apr (A, P, L). Bend Co., 19 Oct (A). Boulder Co., 9 Sep-30 Nov (A, P, L). Delta Co., 9-17 Sep (A, P, L). Denver Co., 16 Oct (A). Douglas Co., 3 Apr-23 May (A, P, L). Elbert Co., 3 Apr (A, L). El Paso Co., Sep (A). Garfield Co., 28 Jul-22 Aug (A). Gunnison Co., 2 Aug-4 Sep (A, L). Huerfano Co., 3 Apr (P). Jackson Co., 6 Oct (A). Larimer Co., 2 Apr-1 Nov (A, P, L). Las Animas Co., 2 Jul (P, L). Mesa Co., 3 Mar-18 Sep (A, P, L). Mineral Co., Aug (A). Otero Co., 10 May (A, P, L). Park Co., 21 Aug (L). Powers Co., 25 Mar-5 May (A, L). Rio Grande Co., 20 Jun (A). Saguache Co., 4 Aug (A). Summit Co., 26 Apr (L). Teller Co., 9 Aug (L). Weld Co., 18-23 Mar-5 Jun (A). Yuma Co., 12-29 Sep (A, P, L).

Simulium (Simulium) arcticum Malloch
[Complex]
Figs. 359-374

Simulium arcticum Malloch, 1914:37, Fig. 4 (female).

Type material.— Holotype female; Kaslo, British Columbia, Canada, July 4, R.P. Currie (Malloch lists the collector as H.G. Dyar, but the label on the specimen pin reads R.P. Currie); USNM, Type

#15410.

This widespread western species complex, which includes at least five cytotypes (Shields and Procunier 1982), ranges from Alaska south to New Mexico, and from California east to Nebraska. The exact cytospecies present in Colorado are not known. Typically, the immature stages can be found in fast, often turbulent, clear, cold montane streams varying from less than 30 cm wide to broad rivers. In southern Utah, the authors found this species in huge numbers in the warm waters of the Fremont River, and nearby tributaries, which are heavily laden with silt. Most of the pupae collected from this latter area were almost completely covered by a dense layer of silt which did not seem to hinder the escape of the fully formed adults. The wide disparity of habitats possibly is referable to various cytotypes. The larvae and pupae often are heavily concentrated, and pupae may be found several deep on submerged branches or on the upper sides of submerged rocks. Adults apparently are pests of horses and cattle and, to a lesser extent, man. A single female of *S. arcticum* was taken, in company with a male and female of *S. canadense*, on January 16, 1993, resting on snow along the margins of Trout Creek in Chaffee Co. The immatures often are found in cold streams, but the earliness of the date is unusual for adults even of this species.

Colorado distribution.—1,525-3,200 m. Alamosa Co., 3 Apr (P, L). Archuleta Co., 4 Apr (L). Boulder Co., 9-25 Sep (A, P, L). Chaffee Co., 16 Jan-4 Sep (A, L). Douglas Co., 3 Apr (P, L). Eagle Co., 7 Apr-27 Jun (A, L). Garfield Co., 7 Apr-26 Jul (A, P, L). Grand Co., 26 Jun-13 Sep (A, P, L). Gunnison Co., 21 Jun-4 Sep (A, P, L). Hinsdale Co., 10 Sep (L). Huerfano Co., 3 Apr-11 Sep (A, P, L). Jackson Co., 28 Jul-5 Aug (L). Jefferson Co., 3 Jun (A). La Plata Co., 4 Apr (A, P, L). Larimer Co., 2 Apr-30 Sep (A, P, L). Logan Co., 13 Jul (A). Mesa Co., 3 Mar-8 Oct (A, P, L). Montrose Co., 3 Mar (L). Pitkin Co., 12 Aug (A). Rio Grande Co., 20-25 Jun (A). Teller Co., 2-8 Aug (A, P, L).

Simulium (Simulium) corbis Twinn [Complex]

Figs. 375-391

Simulium (*Simulium*) *corbis* Twinn, 1936:147, Figs. 15B, 1-5 (female, male, pupa).

Type material.— Holotype female (reared from pupa); Blanche River, about 5 miles south of Perkins Mills, Quebec, pupa collected 22 May, adult emerged 26 May 1935, C.R. Twinn; CNC, Type #4131.

This species has not yet been found in Colorado but has been reported from Idaho and Utah and is known from Wyoming. It has been included in the keys to make them more complete and to assist in the overall identification of the members of this group of species.

Colorado distribution.—Not yet known from the state.

Simulium (Simulium) decorum Walker [Complex]

Figs. 392-411

Simulium decorum Walker, 1848:112 (female).

Type material.— Holotype female; St. Martin's Falls, Albany River, Hudson's Bay, Ontario, G. Barnston; NHM.

This distinctive species is widespread throughout Canada and western U.S.A. In Colorado the species is most common along the eastern front of the Rocky Mountains, and although wide ranging, it never seems to be very abundant at any one place. The immatures are most commonly found in cool to moderately warm, clean, moderately flowing streams with abundant trailing vegetation. They are particularly prevalent in streams emerging from small reservoirs, beaver dams, etc., but are not confined to such habitats. Although larvae may occur in fairly large masses, the pupae usually do not occur in large, deep concentrations. The females have been reported to feed on a variety of wild animals but are not known to feed on domestic farms animals or man in Colorado. This species is known to consist of three "subgroups" in temperate North America (Rothfels 1981), but which subgroup is represented in the state remains unknown.

Colorado distribution.—1,525-3,200 m. Boulder Co. 14-18 Aug (A, P). Douglas Co., 23 May (L). Jackson Co., 18 Aug (A). Lake Co., 16 Jul (A). Larimer Co., 10 May-30 Sep (A). Teller Co., 8 Aug (L). Yuma Co., 17 Sep (A. P, L).

Simulium(Simulium) defoliarti
Stone and Peterson [Complex]
Figs. 412-430

Simulium defoliarti Stone and Peterson, 1958:1, Figs. 1-17 (female, male, pupa, larva).

Type material.— Holotype female (reared, pupal pelt and cocoon mounted on slide); Smith's Fork Creek at Lander Trail, 8.5 miles from Smoot entrance, Lincoln Co., Wyoming, 11 Aug 1956, G.R. DeFoliart; USNM, Type #63961.

This species is known to be a complex of several cytospecies, but which cytospecies might be present in Colorado remains unknown. The morphospecies ranges from British Columbia and southwestern Alberta (Currie 1986), south to Utah and Colorado, but has been found only in one locality in the latter state. The immature stages are found in habitats similar to, and often with, those inhabited by *S. arcticum*. Curtis (1954) reported this species to feed on cattle in British Columbia, and at times seriously affected weight gain in these animals. Adults sometimes fly about humans but are not known to bite man. What little is known about the biology of this species is summarized by Stone and Peterson (1958), Curtis (1954) and Currie (1986).

Colorado distribution.— 2,440 m. Clear Creek Co., (P, L).

Simulium (Simulium) hunteri Malloch
Figs. 431-447

Simulium hunteri Malloch, 1914:59, Fig. 3 (female).

Type material.— Holotype female (abdomen mounted on slide); Virginia Dale, Colorado, 31 Sep 1912, F.C. Bishopp, from cows; USNM, Type #15413.

In Colorado, the immature stages of this little known species occur in small, cold water streams and rivers at higher elevations. Our material was collected between 2,745 and 3,660 m, but it probably occurs as low as about 1,370 m in cold water streams. Larvae and pupae have been found on rocks and trailing vegetation, and sometimes are rather heavily covered with silt. The immature stages can be found from about midsummer at lower elevations until mid- to late September at the higher elevations. Malloch (1914) reported the type series females were taken on cows, and Peterson (1956) reported them biting humans. Females also have been reported feeding on blue grouse (Williams et al. 1980).

Colorado distribution.— 2,745-3,660 m. Boulder Co., 9 Jul-11 Sep (A, P, L). Chaffee Co., (P, L). Gilpin Co., 7-9 Jul (A, P). Hinsdale Co., 4 Sep (A). Larimer Co., 23 Mar-30 Sep (A, P, L). Mesa Co., 11 Aug (A). Summit Co., 21 Aug (A, P, L). Teller Co., 8 Aug (L). Weld Co., 20-21 Jul (A).

Simulium (Simulium) jacumbae
Dyar and Shannon
Figs. 448-462

Simulium jacumbae Dyar and Shannon, 1927:44, Figs. 113-114 (male).

Type material.— Holotype male (mounted whole on slide); Jacumba Springs, California, E.A. McGregor; USNM, Type #28348

This little known species reportedly ranges from California, Nevada, Utah, Colorado, Nebraska and Kansas south into Mexico and Guatemala (Stains and Knowlton 1943; Peterson 1960; Stone and Boreham 1965; Pruess in litt.). Typically, it is an arid country species, occurring in small, often spring-fed streams of moderate flow. Stone and Boreham (1965) found the immature stages attached to rocks, roots and trailing grasses in California. The feeding habits of the female are not known. Stone and Boreham (1965) provided illustrations and brief descriptions of the adults, pupa and larva of this species, and a few notes on the biology.

Colorado distribution.— 1,370-2,745 m. Crowley Co., 2 Sep (A). Gunnison Co., 1 Jul (A). Jackson Co., 2 Sep (A). Larimer Co., May-Aug (A). Weld Co., 26 Jul-29 Sep (A).

Simulium (Simulium) piperi
Dyar and Shannon
Figs. 463-478

Simulium piperi Dyar and Shannon, 1927:38, Figs. 129-130 (male).

Type material.— Holotype male (terminalia mounted on slide); Seattle, Washington, C.V. Piper; USNM, Type #28344.

This widespread species ranges from Alberta and British Columbia, south into California and New Mexico. In Colorado, the immature stages

are usually found on trailing vegetation, but have been collected from twigs and small rocks in small to medium sized, cool to warm water rivers with a moderate rate of flow. In Alberta, Currie (1986) reported the immatures stages of this species appeared to prefer warm outflows from beaver ponds, and in Nebraska, Pruess and Peterson (1987) found it common on leaves of watercress in slow currents of clean, cold, spring-fed streams. Hall (1972), and Mohsen and Mulla (1982) provided some ecological notes on the species. Jones (1961) found the female feeding on the sheared abdominal areas of sheep. Currie (1986) illustrated the larva and pupa.

Colorado distribution.— 1,525-2,850 m. Boulder Co., 9-11 Sep (A, P, L). Chaffee Co., 16 Jan-4 Sep (P, L). Clear Creek Co., 10 Jul-6 Aug (A). Douglas Co., 3 Apr (L). Eagle Co., 7 Apr (P, L). Elbert Co., 3 Apr (A, P, L). Garfield Co., 26 Jul-22 Aug (A). Grand Co., 11 Aug (A). Jefferson Co., [CSU]. La Plata Co., 4 Apr (L). Larimer Co., 22 Mar-28 Oct (A, P, L). Los Animas Co., 30 Jan (L). Mesa Co., 1 May-9 Oct (A, L). Pueblo Co., 30 Jan (L). Teller Co., 2-8 Aug (A, P, L).

Simulium (Simulium) tuberosum
(Lundström) [Complex]
Figs. 479-492

Melusina tuberosa Lundström, 1911:14, Fig. 10 (male).

Type material.— Holotype male (terminalia apparently mounted on a slide); Enontekis, Finnish Lapland, Finland, Frey. According to Rubtsov (1956; and 1989 English translation) the types have not been studied. We are uncertain of the location of the type.

This Holarctic entity comprises a complex of about nine cytotypes (Landau 1962; Mason 1982, 1984; Adler 1986; Adler and Kim 1986). Representatives of this small, dark species are widespread throughout Colorado, but to our knowledge only two cytotypes, FG and St/FG, are known from the state. The complex has recently been studied by Adler, and when his manuscript is published we may have to use another name for the Colorado representatives of this complex. Its status as a pest of man, and domestic and wild animals is contradictory and unclear. Stone and Snoddy (1969) mentioned that *S. tuberosum* was a most persistent pest of man and livestock in Alabama, and Burger and Pistrang (1987) critically reviewed the literature on this species complex and concluded that females only occasionally bite or annoy humans. To our knowledge, females are not major pests of either man or animals in Colorado. Larvae and pupae are most frequently found on trailing vegetation in moderately flowing portions of small to medium sized streams and rivers. Large populations of the immature stages were found in the cool outlet streams from The Loc Lake, at an elevation of 3,260 m, and in many similar streams in the higher elevations. Stone and Snoddy (1969) provide some biological information as well as illustrations of all life history stages of this species in Alabama.

Colorado distribution.— 1,676-3,566 m. Boulder Co., 23 Aug-25 Sep (A, P, L). Clear Creek Co., 19 Aug (L). Grand Co., 26 Aug-30 Sep (A, P, L). Gunnison Co., 1 Jun-30 Jul (L). Jackson Co., 28 Jul-5 Aug (A, P, L). Larimer Co., 7 Jul-30 Sep (A, P, L). Park Co., 21 Aug (L). Summit Co., 21 Aug (P, L). Teller Co., 2-8 Aug (P, L).

Simulium (Simulium) venustum
Say [Complex]
Figs. 493-506

Simulium venustum Say, 1823:28 (also see: 1859, Le Conte, J.L., ed. The Complete Writings of Thomas Say on the Entomology of North America. Vol. 2:51) (male, female).

Type material.— Holotype female; Shippingsport, Ohio (collection date was between 5 May and 9 Jun); type probably lost.

This species is not common in Colorado although it is known from several counties. *Simulium venustum* is a complex of about 10 cytotypes (Rothfels et al. 1978; Rothfels 1981) that cannot be reliably separated by morphological means. Cytospecies CC is the only cytospecies of this complex definitely known to the authors from Colorado. The immature stages were most frequently found on trailing grass blades, often in combination with *S. tuberosum* in the lower range of elevation for the latter species. We are unaware of this species being a nuisance or a pest of either man or animals in the state like it is in the northeastern states and eastern Canada. Much biological information has been published on this species. However, because of the numerous cytotypes in this complex, and because this complex ofter

has been confused with *S. verecundum* Stone and Jamnback, reliable biological information is largely lacking. Much needs to be done with this complex, especially since one or more cytotypes constitute major pests in various portions of northeastern North America.

Colorado distribution.— 1,525-2,740 m. Boulder Co., 25 Jul (A). Jackson Co., 16 Jul-18 Aug (A, L). Larimer Co., 16 Jul-10 Sep (A). Weld Co., 29 May-31 Aug (A).

Simulium (Simulium) verecundum
Stone and Jamnback [Complex]
Figs. 507-520

Simulium (*Simulium*) *verecundum* Stone and Jamnback, 1955:83, Pl. 7, Fig. 25; Pl. 10, Fig. 41 (female, male, pupa, larva).

Type material.— Holotype male (reared) (terminalia mounted on slide); Monroe Co., Pennsylvania, June 4, 1948, A. Stone; USNM, Type #62361.

As with the previous species, *S. verecundum* apparently is uncommon or has not been widely collected in Colorado. We know it from a single locality but it probably has a distribution in the state similar to that of *S. venustum* and, on occasion, may have been misidentified as that species. The various cytotypes have yet to be resolved morphologically. Which of these cytotypes might occur in Colorado is unknown. Prior to 1955 when this species was described, it had been misidentified and lumped in with *S. venustum* because the female, pupa, and larva of the two species are so similar. Females of these species are now distinguishable, but only the males are easy to separate. Living larvae of *S. verecundum* are said to be entirely white in contrast to the distinct reddish tinge of larvae of *S. venustum* (Stone and Snoddy 1969). However, this is highly variable and not a reliable character to separate these species. Pupae of the two species cannot yet be distinguished. Even after the formal description of *S. verecundum*, most authors dealing with these two species treated them together because of the difficulties in identification, and consequently, reliable data for each species is largely unavailable. Stone and Snoddy (1969) mentioned that the females do not seem to annoy man, but Abdelnur (1968) collected females feeding on cattle in Alberta. Martin and Edman (1993) studied the assimilation rates of different particulate foods by *S. verecundum* and found that bacterial assimilation was significantly more efficient than assimilation of the diatom or blue green alga also tested. This biological study is one of the few specifically directed at this black fly species.

Colorado distribution.— 1,828 m. Grand Co.-Jackson Co., 18 Jul (A).

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GLOSSARY

Most of the morphological terms used in the keys are well known and do not require definition. For those unfamiliar with the terminology used for black fly morphological features, the following terms are defined, most are illustrated, and labeled on one or more drawings. The definitions given below closely follow those given by McAlpine (1981) and Teskey (1981) in volume 1 of the Manual of Nearctic Diptera, and Wood (1991).

Adults

Aedeagal guide. See ventral plate of aedeagus.

Aedeagus. The membranous, basically tubelike, structure through which semen moves and passes out the gonopore (intromittent organ) (see median sclerite).

Anal lobe. The lateral sclerite of the female terminalia situated just anterior to the cercus and dorsal to the hypogynial valves (Fig. 22). Wood and Borkent (1982) equate this with sternite 10.

Anepisternal membrane. The membranous portion of the anepisternum (the anterodorsal portion of the mesopleuron anterior to the pleural suture and dorsal to the anapleural suture. The anepisternum is divided by this membranous area (called the anepisternal cleft) which extends ventrally in front of the pleural suture to the anapleural suture). In black flies, this membranous area is rather large and may be bare or sparsely setose (Fig. 7).

Basal cell. A tiny, but variable, cell present at the proximal origin of the branches of the cubital vein and the origin of the base of vein R dorsally.

Basal fringe. The fringe of long setae on the dorsal and lateral surfaces of the basal scale (first abdominal tergite).

Basal scale. The anterior collarlike area of abdominal tergite 1, bearing a fringe of long setae and the first pair of abdominal spiracles. This is sometimes called the abdominal scale.

Basal tooth. A moderately large to large toothlike process at the base of the female claw that gives the claw a bifid appearance (Fig. 13).

Basicosta. The short, stout vein on the costal margin proximal to the humeral cross-vein, beset with dense, moderately long setae (Fig. 6).

Basitarsus(i). The first or proximal tarsomere, especially of the hind leg (Fig. 9). This is the longest of the tarsomeres.

Calcipala. A variable sized, flattened lobe at the apex of the inner side of the hind basitarsus (Fig. 10), this sometimes absent.

Cercus(i). The prominent distal element of the female proctiger (Fig. 22). The anal opening is situated between the cerci.

Endoparameral organ. See paramere.

Flagellomere(s). Each individual subdivision of the antennal flagellum, usually 9 in number but sometimes 7 or 8.

Genital fork. A sclerotized, somewhat Y-shaped sclerite representing sternite 9 of the female, with an anteriorly directed stem and two posteriorly directed arms lying internal and dorsal to the hypogynial valves of sternite 8, and each arm connected dorsolaterally with tergite 9 (Fig. 22).

Gonocoxite(s). The basal segment of the two segmented gonopod (clasper) of the male terminalia (Fig. 21).

Gonostylus(i). The distal segment of the two segmented gonopod (clasper) of the male terminalia (Fig. 21).

Hypogynial valve(s). the posterior flaplike lobe(s) or process(es) of sternite 8 of the female terminalia (Fig. 22), often called ovipositor lobe(s).

Katepisternum. The anteroventral portion of the mesopleuron anterior to the pleural suture and ventral to the anapleural suture. This sclerite is divided into upper and lower portions by a variably distinct, horizontal groove or katepisternal sulcus (Fig. 7), and is usually bare but may have a small patch of setae along the dorsal margin.

Katepisternal sulcus. See katepisternum above (Fig. 7).

Median sclerite. A variously sclerotized, often basically Y-shaped structure whose stem and arms vary considerably in length. It lies along, supports and forms the ventral surface of the aedeagus of the male (Fig. 29) (see aedeagus).

Mesepimeral tuft. A variably extensive tuft of fine setae present on the mesepimeron below the base of the wing. This tuft is absent in species of the genus Parasimulium.

Palpomere(s). Each individual subdivision of the palpus.

Paramere(s). Separate paired structures associated with the base of the aedeagus. Each consists of a variously shaped, sclerotized structure attached to the gonocoxal apodeme (in the subgenus *Parahelodon* the attachment has been lost but remains closely associated with the gonocoxal apodeme), and lies in the area between the anal and genital openings. It usually consists of a variously enlarged base and a more slender free arm that may have one or more long or short spiniform processes or none (Fig. 29). This is often referred to as the endoparameral organ.

Pedisulcus. The variably deepened notch near the basal third of the dorsal surface of the hind tarsomere (Fig. 10), sometimes absent.

Radial sector (Rs). The posterior (sectoral) branches of the radius (R) vein of the wing. The Rs may be simple (Fig. 5), or divided into anterior (R2+3) and posterior (R4+5) branches of varying lengths (Figs. 4, 6).

Sensory vesicle. The sensory organ located in the third palpomere of the maxillary palpus (fig. 55).

Stem vein. The short, stout, proximal section of vein R that is usually delimited apically by a transverse suturelike mark or constriction near the level of the humeral crossvein (h). It is beset with short setae the color of which often are of taxonomic importance (Fig. 6).

Subbasal tooth. A tiny to moderately large toothlike process situated near the base of the female claw (Fig. 10).

Tarsomere(s). Each individual subdivision of the tarsus.

Ventral plate of the aedeagus. The prominent, variously shaped sclerite situated ventral to the aedeagus and dorsal to and between the bases of the gonocoxites (Fig. 10). This is more properly termed the aedeagal guide (Wood 1991).

Immature Stages

Anal papillae. The retractable, thin-walled, membranous organ that arises within the anus and has an osmoregulatory function. It typically consists of three, short papilliform lobes that are simple or compound in structure (Figs. 17-18).

Anal sclerite. In the larva the dorsal sclerite, typically X-shaped (sometimes Y-shaped, rectangular, or absent), lying posterior to the anal opening and anterior to the posterior circlet of hooks (Fig. 18).

Anal setulae. Short setulae or flattened scalelike setulae scattered on the posterodorsal, and sometimes lateral, portion of the larval abdomen, but are most common and numerous just lateral and posterior to the anal sclerite.

Cephalic apotome. See frontoclypeal apotome.

Cephalic fan(s). See labral fan(s).

Cervical sclerite(s). A small, free sclerite lying posterior to the frontoclypeal apotome and medial to the postocciput of the larval head capsule, sometimes it is enclosed by the medial terminus of the postocciput (fig. 25).

Circlet of hooks. See proleg, and posterior circlet of hooks.

Cocoon. A 'silken' covering of the pupa that varies from a few silken threads to a dense shapeless baglike structure, to slipper-shaped without a complete anteroventral collar, to boot-shaped with an anterior collar that connects the two sides anteroventrally and is narrowly or broadly raised so the anterior aperture is above the substrate on which the cocoon is attached.

Frontoclypeal apotome. The dorsomedial sclerite of the larval head capsule lying between the ecdysial lines (Fig. 25).

Gill. See respiratory organ.

Head spots. The dark (positive) or pale (negative) spots or markings on the frontoclypeal apotome of the larval head capsule that represent muscle attachment sites. These groups of spots are usually designated as anteromedian, posteromedian, anterolateral and posterolateral (Fig. 25).

Hypostoma. A sclerotized, anteriorly toothed plate situated below the mouthparts and forming the anteroventral portion of the head capsule (Fig. 26). In addition to the hypostomal teeth it also bears a series of hypostomal setae along each lateral margin.

Hypostomal bridge. The central narrowed portion of the larval head capsule where the genae meet ventrally behind the hypostoma and in front of the hypostomal cleft (Fig. 48).

Hypostomal cleft. The unsclerotized indentation or emargination present medially in the hind margin of the ventral surface of the larval head capsule posterior to the hypostomal bridge. This varies considerably in shape and size, ranging from a simple weakening of the integument to a shallow rounded or V-shaped cleft to a deeper subquadrate, subrectangular, broadly rounded or V-shaped cleft (Fig. 26).

Hypostomal teeth. The variable series of teeth or serrations on the anterior margin of the hypostoma. The hypostomal teeth usually consist of a stout median tooth and strong lateral (corner) teeth with smaller sublateral teeth between them, and with small paralateral teeth and lateral serrations anteriorly on each lateral margin (Fig. 48).

Labral fan(s). A fanlike organ situated at the anterolateral corner of the frontoclypeal apotome, consisting of a stalk and three well-developed fans: a large primary fan arising from apex of stalk, a smaller secondary fan inside and below primary fan, and a small median fan situated on median side of stalk. The primary fan is composed of a series of long, slender, tapered, flattened, curved rays variously pectinate on underside. Secondary fan composed of rays essentially like those of primary fan but with longer setae. The median fan is composed of straight flexible rays lying parallel to each other in a straight line but not spreading out when entire fan is open (Fig. 14). The fan is absent in some genera.

Mandibular phragma(ta). The dark, heavily sclerotized barlike sclerite along the anterior margin of the gena just posterior to the larval mandible (Fig. 14).

Posterior circlet of hooks. The series of closely set rows of minute hooks on the posterior end (posterior proleg) of the larva (Figs. 14-18).

Postgenal bridge. See Hypostomal bridge.

Postgenal cleft. See Hypostomal cleft.

Postocciput. The slender, sclerotized, posterior margin of the larval head capsule that extends from near the dorsal ecdysial line ventral to the posterior tentorial pit and posterolateral corner of the hypostomal cleft (Fig. 25).

Proleg (anterior). The midventral, single, fleshy appendage of the prothorax that bears a series of closely set rows of minute hooks apically, and a variable, sclerotized, lateral plate on each side (Fig. 14).

Rectal papilla(e). See anal papillae.

Rectal scales. See anal setulae.

Respiratory organ. The organ (gill) located laterally on the pupal thorax. It varies considerably in structure but usually consists of two to more than 100 slender filaments that may be short or long, pale or dark, or smooth to annulate. Sometimes the filaments are swollen or replaced by enlarged, club- or hornlike lobes. A filament is called sessile if it arises singly, or petiolate if it branches some distance from the base (Figs. 23, 36, 52, 84, 211).

Suboesophageal ganglion [often spelled esophageal]. The ganglion of the larval nervous system that is visible under the integument near or in the base of the hypostomal cleft. It may be pale and difficult to see or dark and easily visible (Fig. 48).

Terminal hooks. A pair of short or long spinelike hooks situated posterodorsally on the terminal segment of the pupal abdomen, sometimes these are absent.

Trichome(s). Specialized seta(e) on the head and thorax of the pupa. They may be erect and simple, bifurcate or multibranched, or even flattened and scalelike.

Ventral tubercle(s). A short, fleshy process, or pair of variable, digitiform processes on the ventral surface of the last abdominal segment of the larva just in front of the posterior circlet of hooks (Fig. 16).

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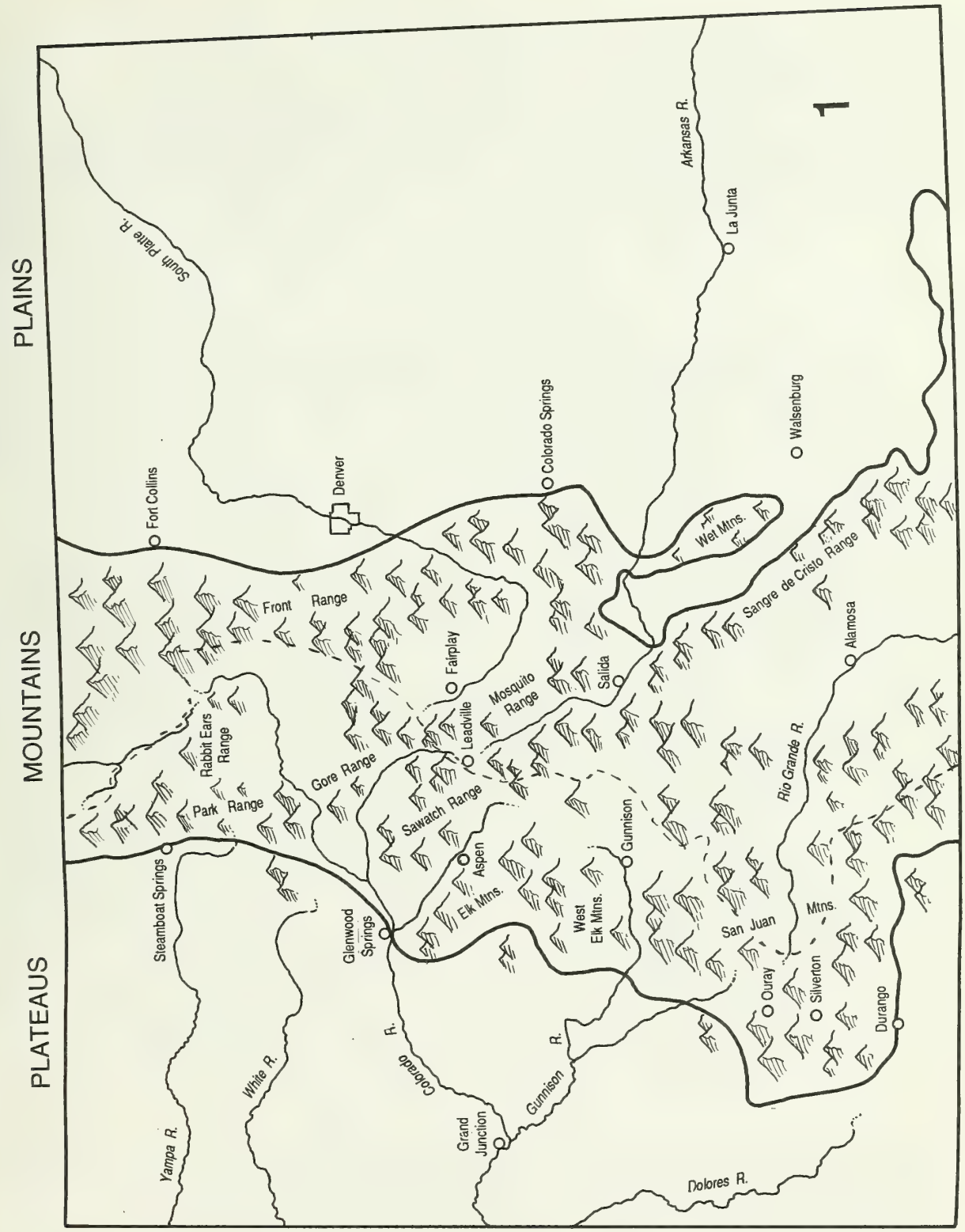
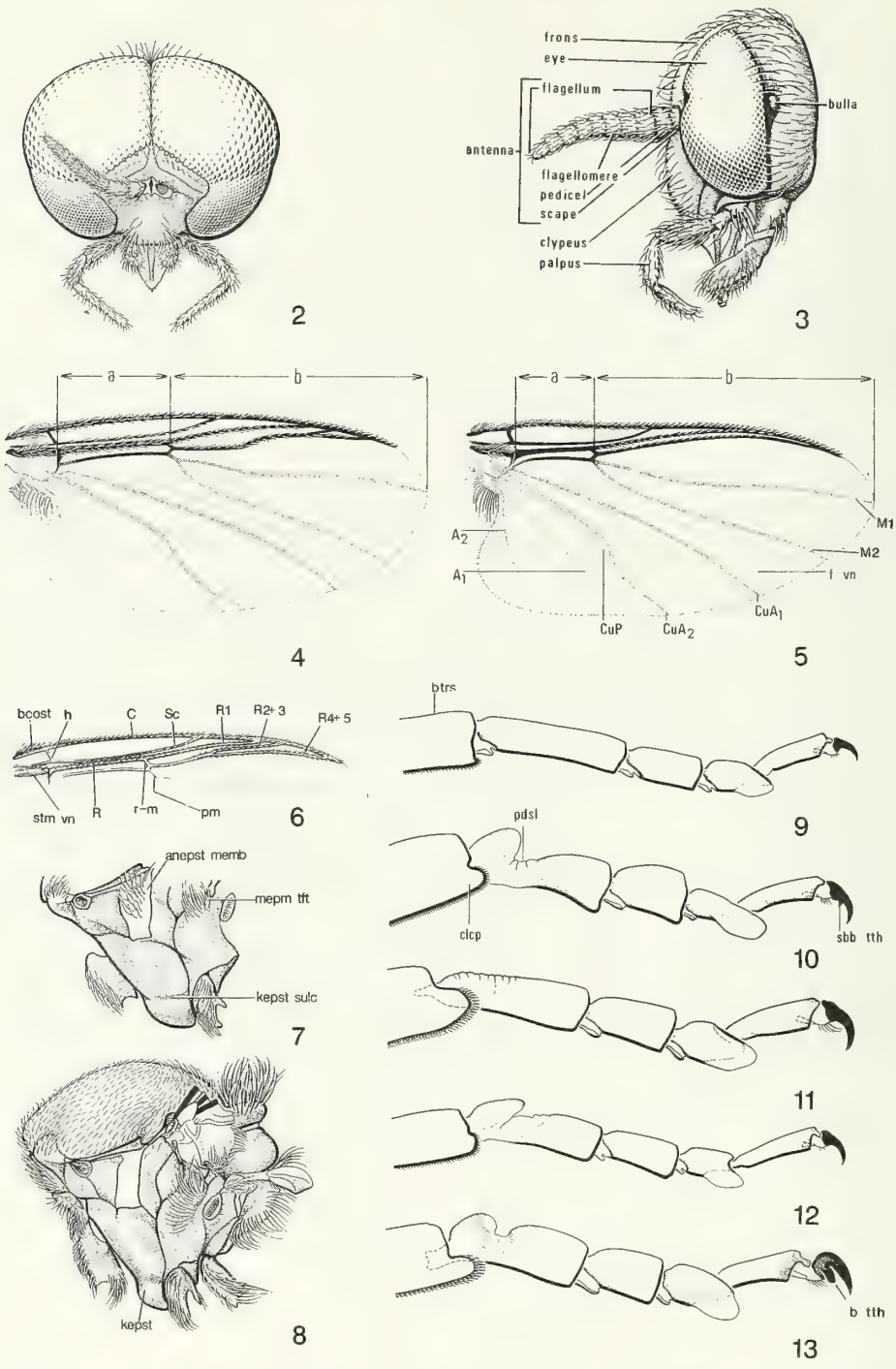
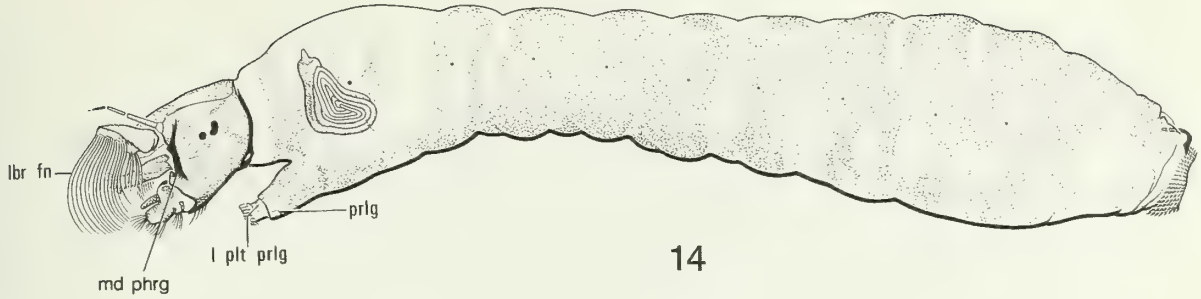


Fig. 1. Physiographic regions of Colorado (Continental Divide indicated by dotted lines) (after Chronic and Chronic 1972).



Figs. 2-13. 2. Head of male *Simulium* (*Simulium*) *decorum*, front view; 3. Head of female *Twinnia* sp. (not known in Colorado), lateral view with parts labeled; 4. Wing of *Cnephia* sp. showing setal patterns and branching of veins; 5. Wing of *Simulium* sp. showing setal patterns and branching of veins; 6. wing, anterior portion, of *Prosimulium* sp. showing veins; 7. Thorax, lower portion, of *Metacnephia* sp., lateral view; 8. Thorax of *Prosimulium* sp., lateral view; 9. Hind tarsus of female of *Prosimulium* sp.; 10. Hind tarsus of female of *Simulium* (*Simulium*) *arcticum*; 11. Hind tarsus of female of *Stegopterna mutata*; 12. Hind tarsus of female of *Simulium* (*Psilozia*) *vittatum*; 13. Hind tarsus of female of *Simulium* (*Byssodon*) *meridionale*. Abbreviations: a, basal section of R; anepst memb, anepisternal membrane; b, base of Rs to apex of wing; bcost, basicosta; btrs, basitarsus (tarsomere); b tth, basal tooth; clcp, calcipala; f vn, false vein; h, humeral crossvein; kepst, katepisternum; kepst sulc, katepisternal sulcus; pdsl, pedisulcus; pm, petiole of media; r-m, radial-medial crossvein; sbb tth, subbasal tooth; stm vn, stem vein.



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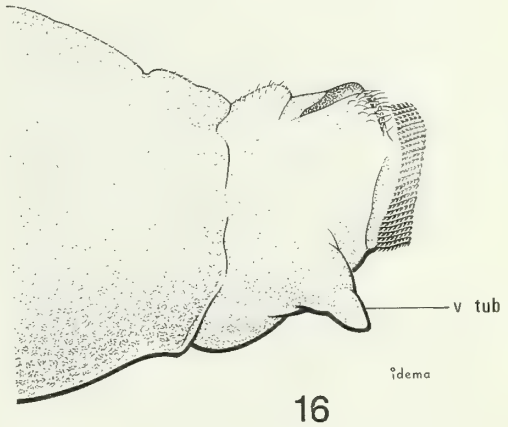

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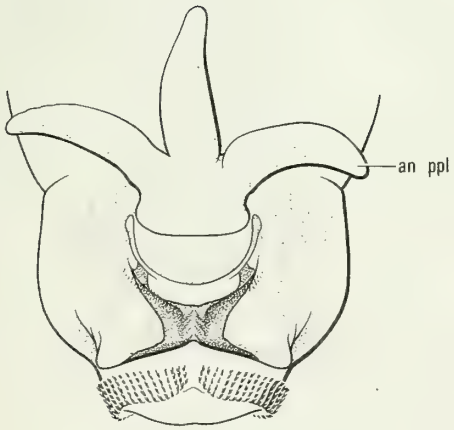

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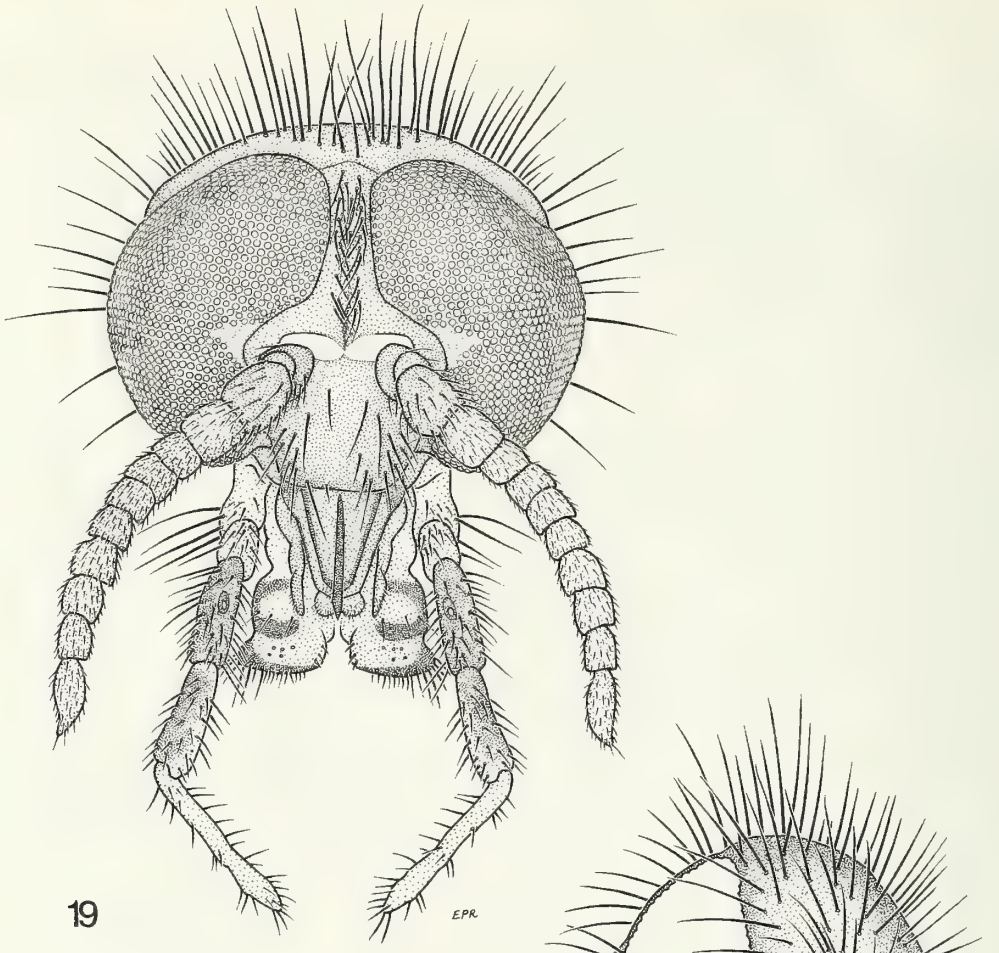
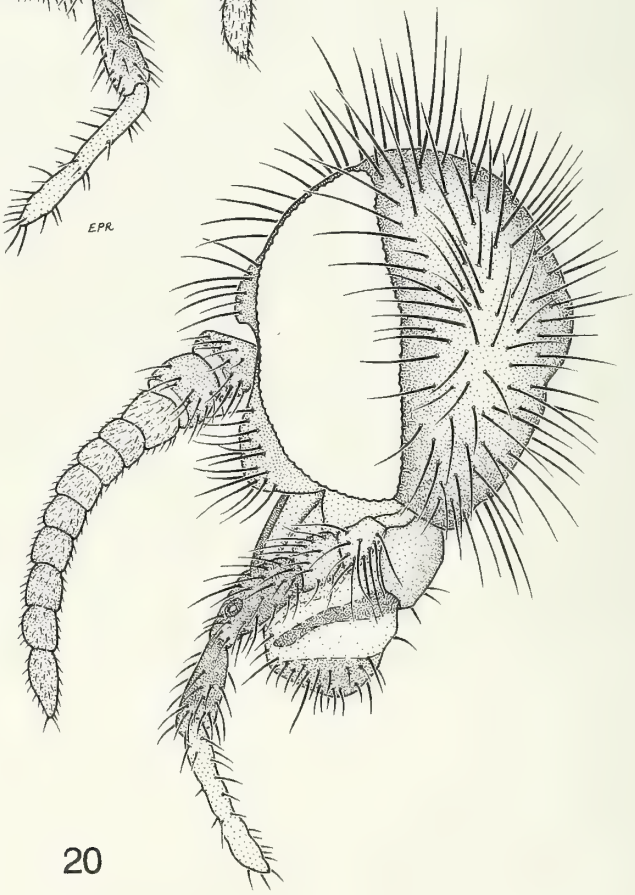
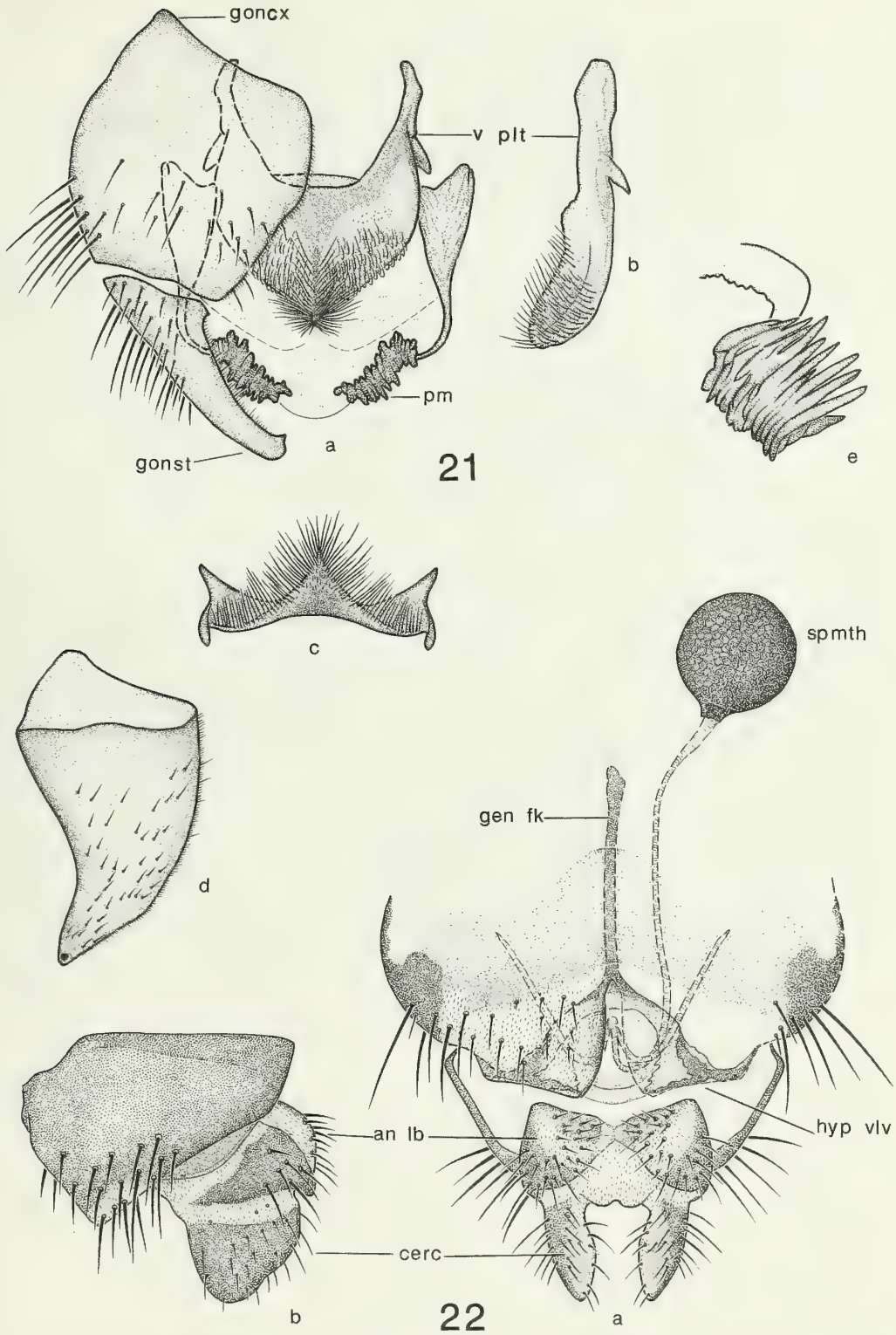
Figs. 14-18. 14. Larva of *Simulium* (*Simulium*) *venustum*; 15. Posterior portion of larval abdomen of *Stegopterna mutata*; 16. Posterior portion of larval abdomen of *Simulium* (*Eusimulium*) *aureum*; 17. Posterior dorsal portion of larval abdomen of *Simulium* (*Psilozia*) *vittatum*; 18. Posterior dorsal portion of larval abdomen of *Simulium* (*Hearlea*) *canadense*. Abbreviations: an ppl, anal papilla; an scl, anal sclerite; lbr fn, labral fan; l plt prlg, lateral plate of proleg; md phrg, mandibular phragma; mv blg, midventral bulge; prlg, proleg; v tub, ventral tubercle..

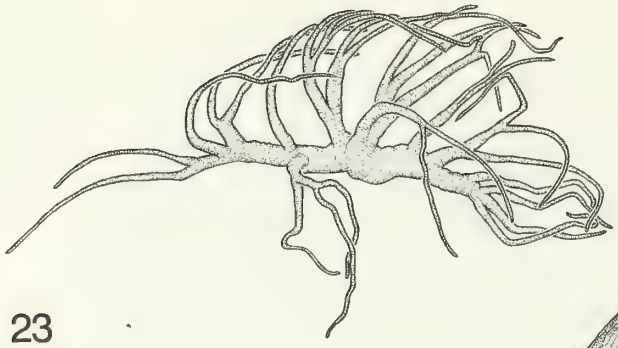


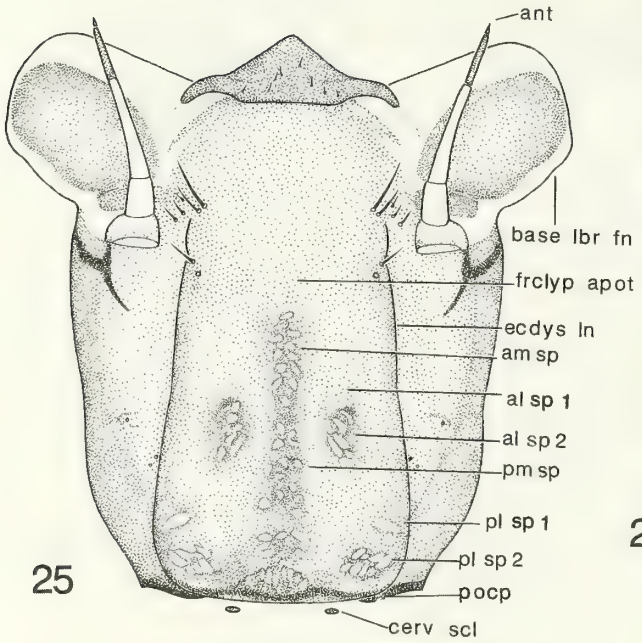


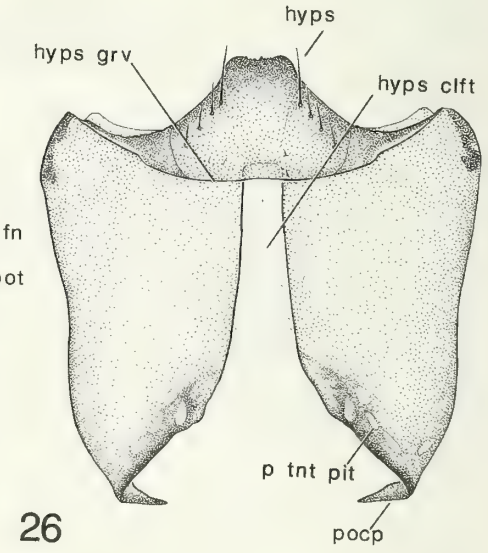
Figs. 19-20. *Metacnephia coloradensis* male. 19. Head, front view; 20. Head, lateral view.

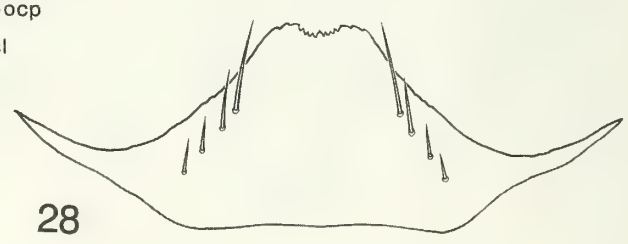


Figs. 21-22. *Metacnephia coloradensis*. 21. Terminalia of male: a) ventral view with left gonocoxite and gonostylus removed; b) ventral plate, left lateral view; c) ventral plate, terminal (end) view; d) left gonostylus, dorsal (inner) view; e) tip of arm of paramere showing armature. Lateral view (b) and terminal view (c) at right angles to plane of ventral view (a). 22. Terminalia of female: a) ventral view; b) right lateral view at right angle to plane of ventral view. Abbreviations: an lb, anal lobe, cerc, cercus; gen fk, genital fork (sternite 9); goncx, gonocoxite; gonst, gonostylus; hyp vlv, hypogynial valve; pm, paramere; spmth, spermatheca; v plt, ventral plate of aedeagus.

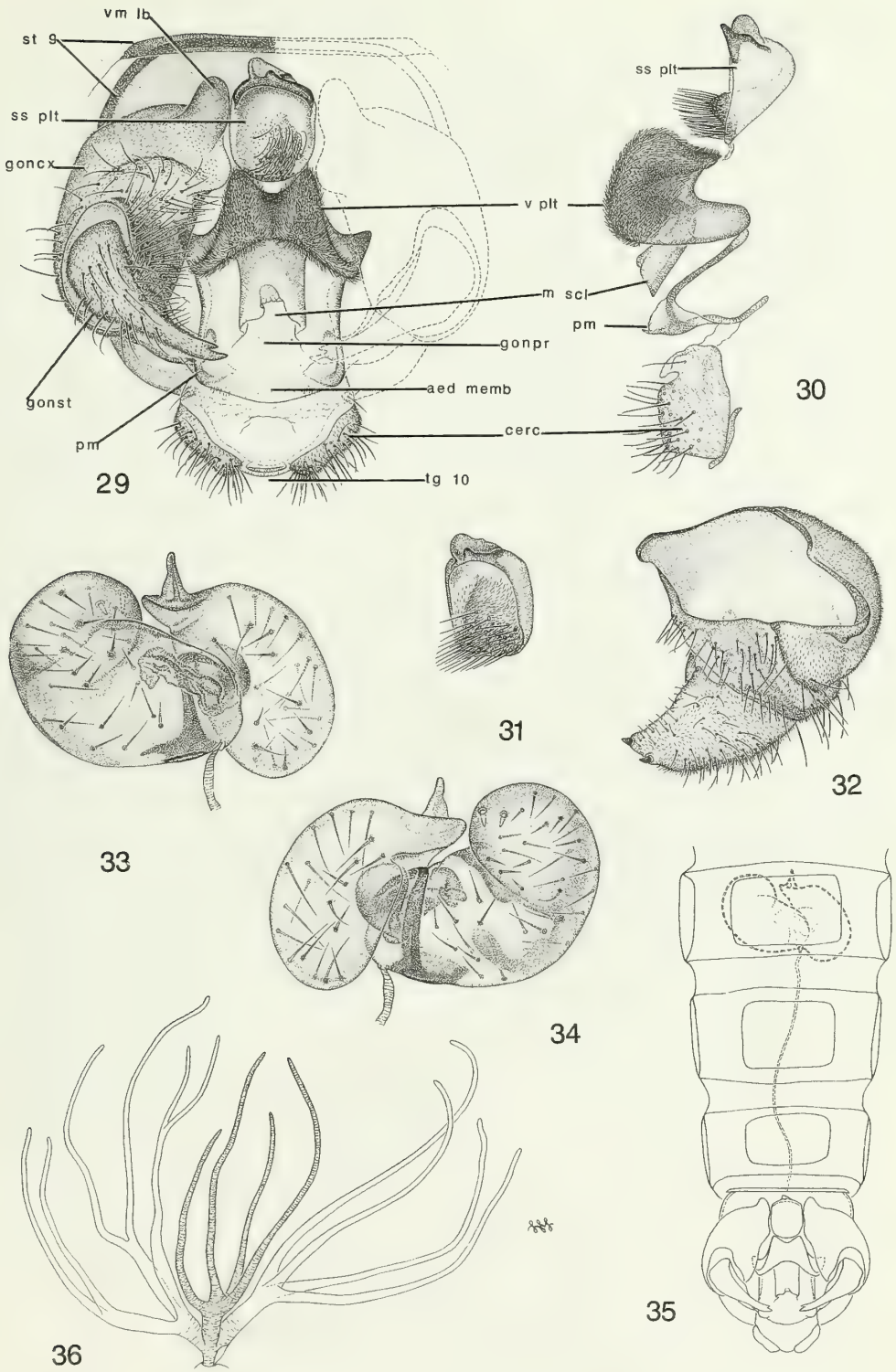




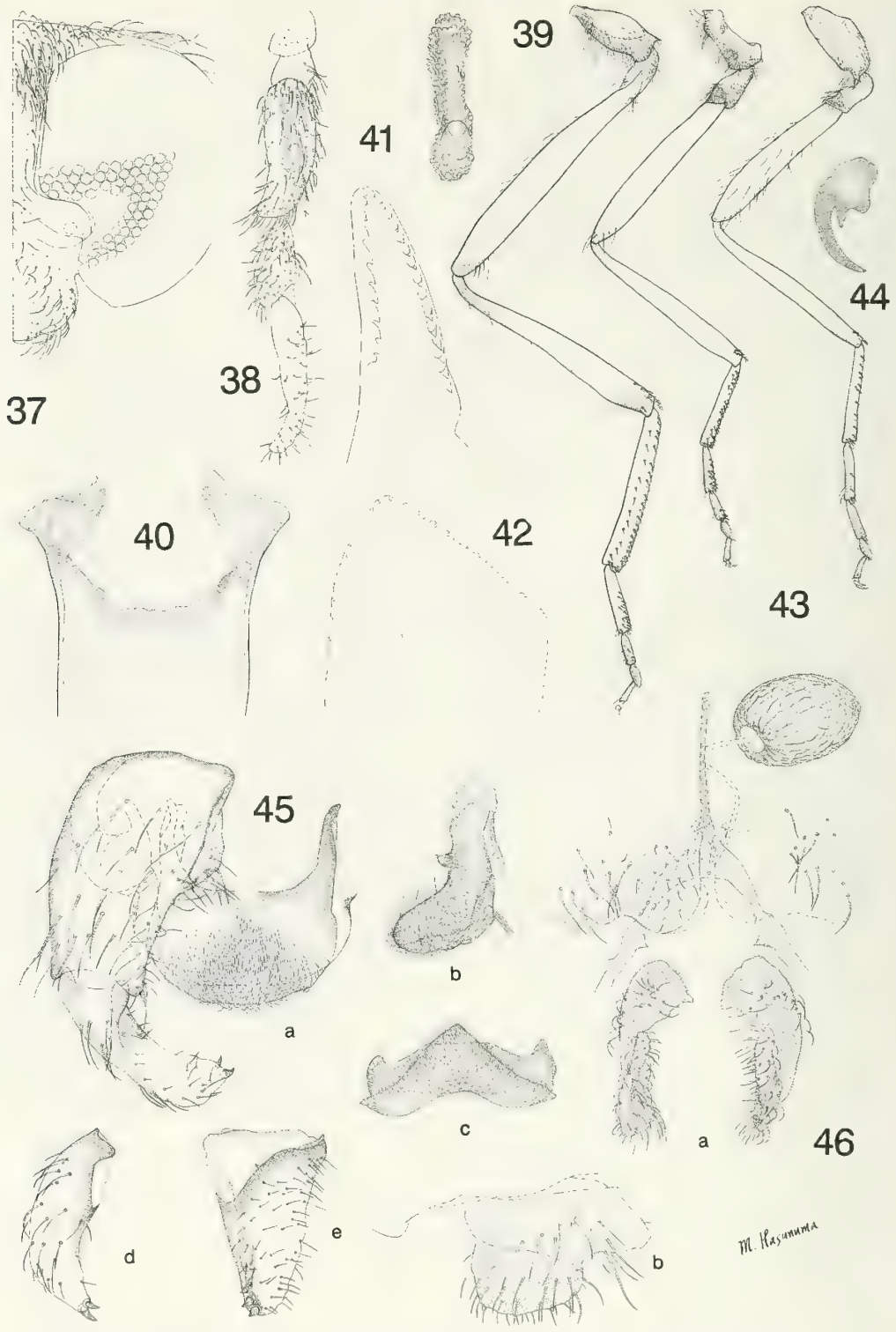




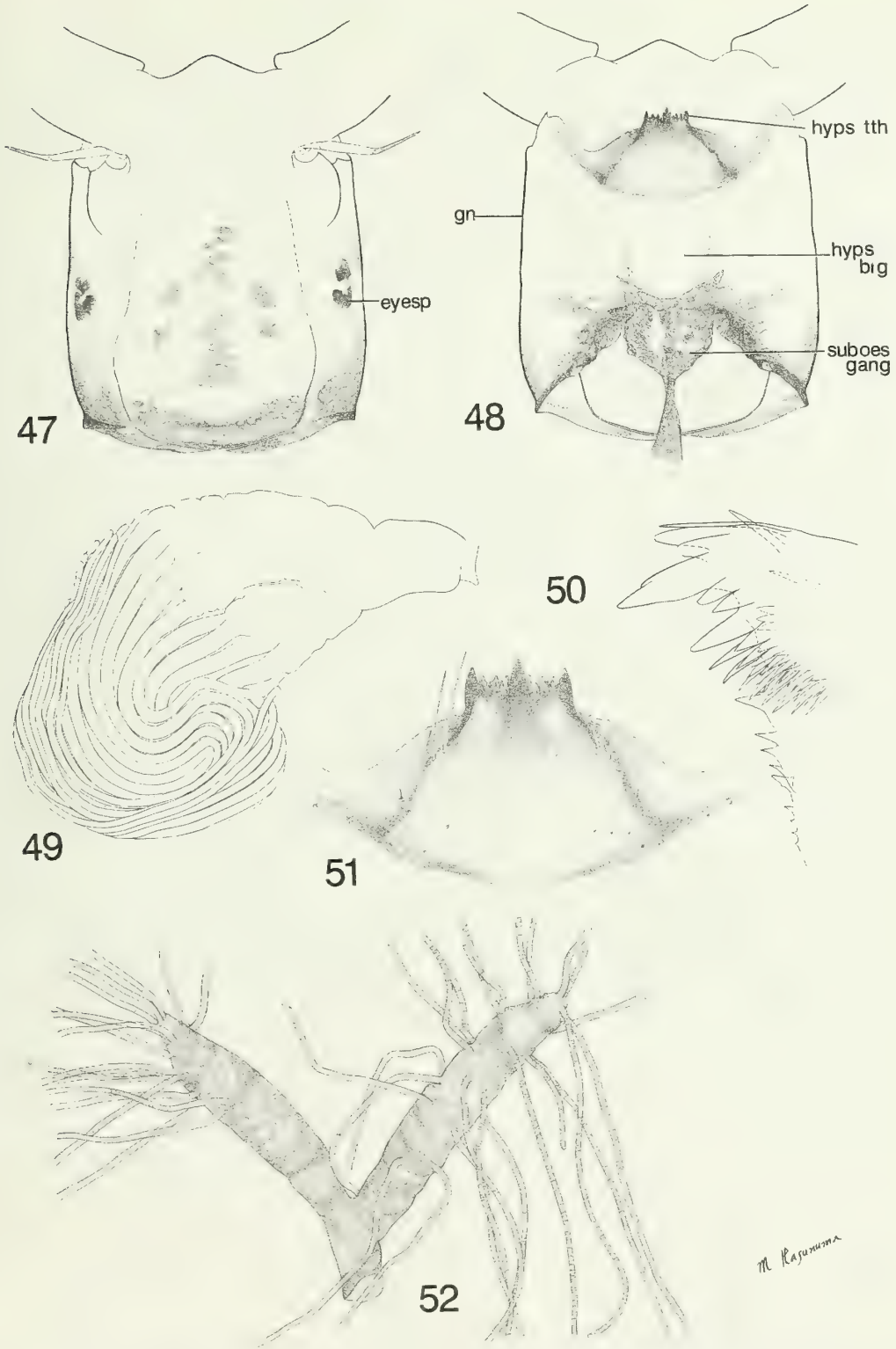
Figs. 23-28. *Metacnephia coloradensis*. 23. Left pupal respiratory organ (gill), inner view. 24. Pupa, right lateral view. 25. Larval head capsule, dorsal view. 26. Larval head capsule, ventral view. 27. Tip of hypostoma showing teeth. 28. Hypostoma, ventral view. Abbreviations: al sp, anterolateral spot (1, and 2); am sp, anteromedial spot; ant, antenna; base lbr fn, base of labral fan; cerv scl, cervical sclerite; ecdys ln, ecdysial line; frclyp apot, frontoclypeal apotome; hyps, hypostoma; hyps clft, hypostomal cleft; hyps grv, hypostomal groove; pl sp, posterolateral spot (1, and 2); pm sp, posteromedial spot; pocp, postocciput; p tnt pit, posterior tentorial pit.



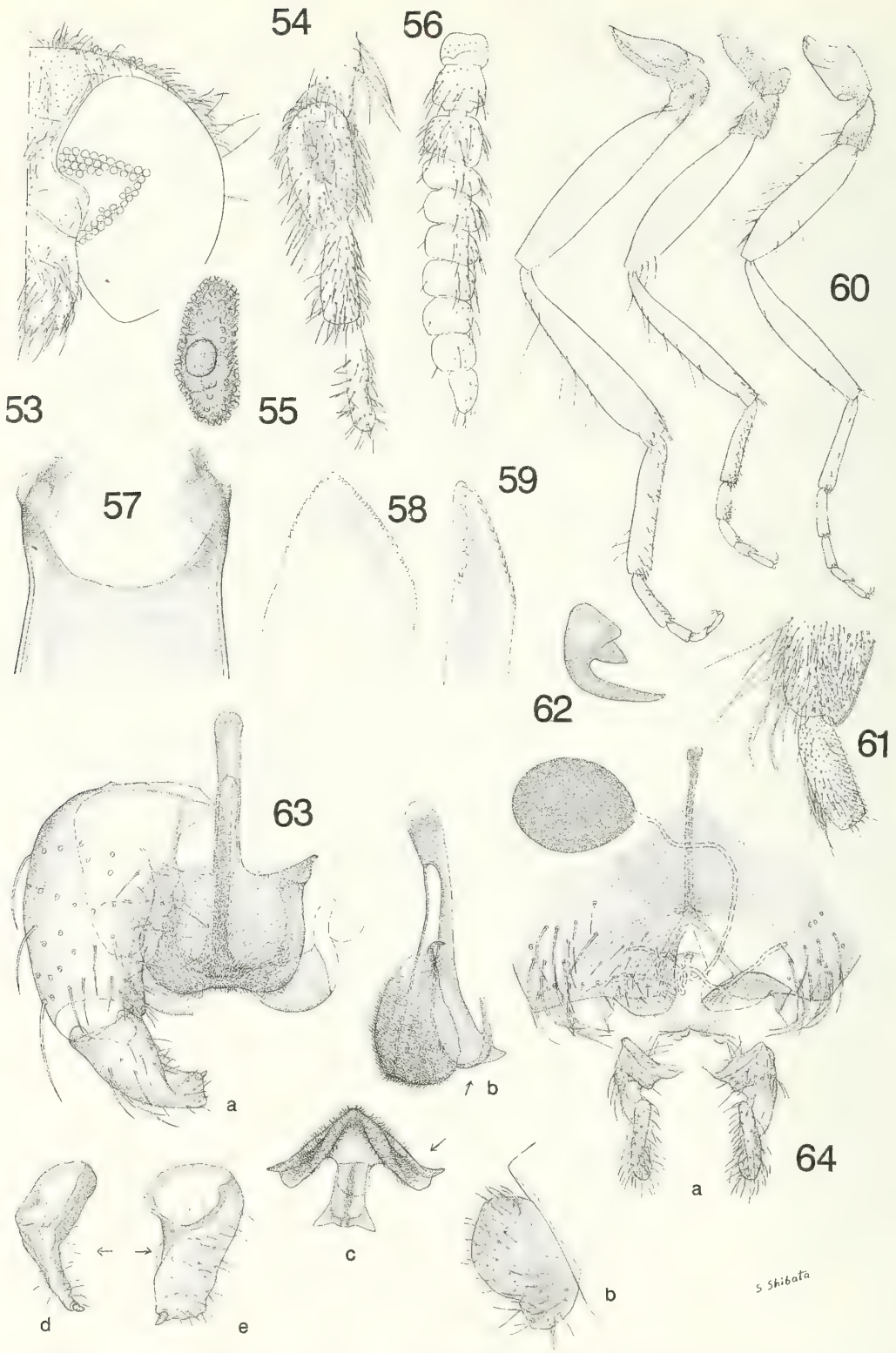
Figs. 29-36. *Piezosimulium jeanninae* male. 29. Terminalia, ventral view. 30. Parts of terminalia, lateral view. 31. Sclerotized, setose plate of terminalia, ventrolateral view. 32. Left gonocoxite and gonostylus dorsal (inner) view. 33. Sperm pump, dorsal view. 34. Sperm pump, ventral view (it is uncertain which is true dorsal and true ventral). 35. Abdomen, ventral view, showing position of sperm pump in relation to abdominal segments and terminalia. 36. Pupal respiratory organ, right lateral view. Abbreviations: aed memb, aedeagal membrane; cerc, cercus; goncx, gonocoxite; gonpr, gonopore; gonst, gonostylus; m scl, median sclerite of aedeagus; pm, paramere; ss plt, sclerotized setose plate; st 9, sternite 9 (hypandrium); tg 10, tergite 10; vm lb, ventromedial lobe of gonocoxite; v plt, ventral plate of aedeagus.



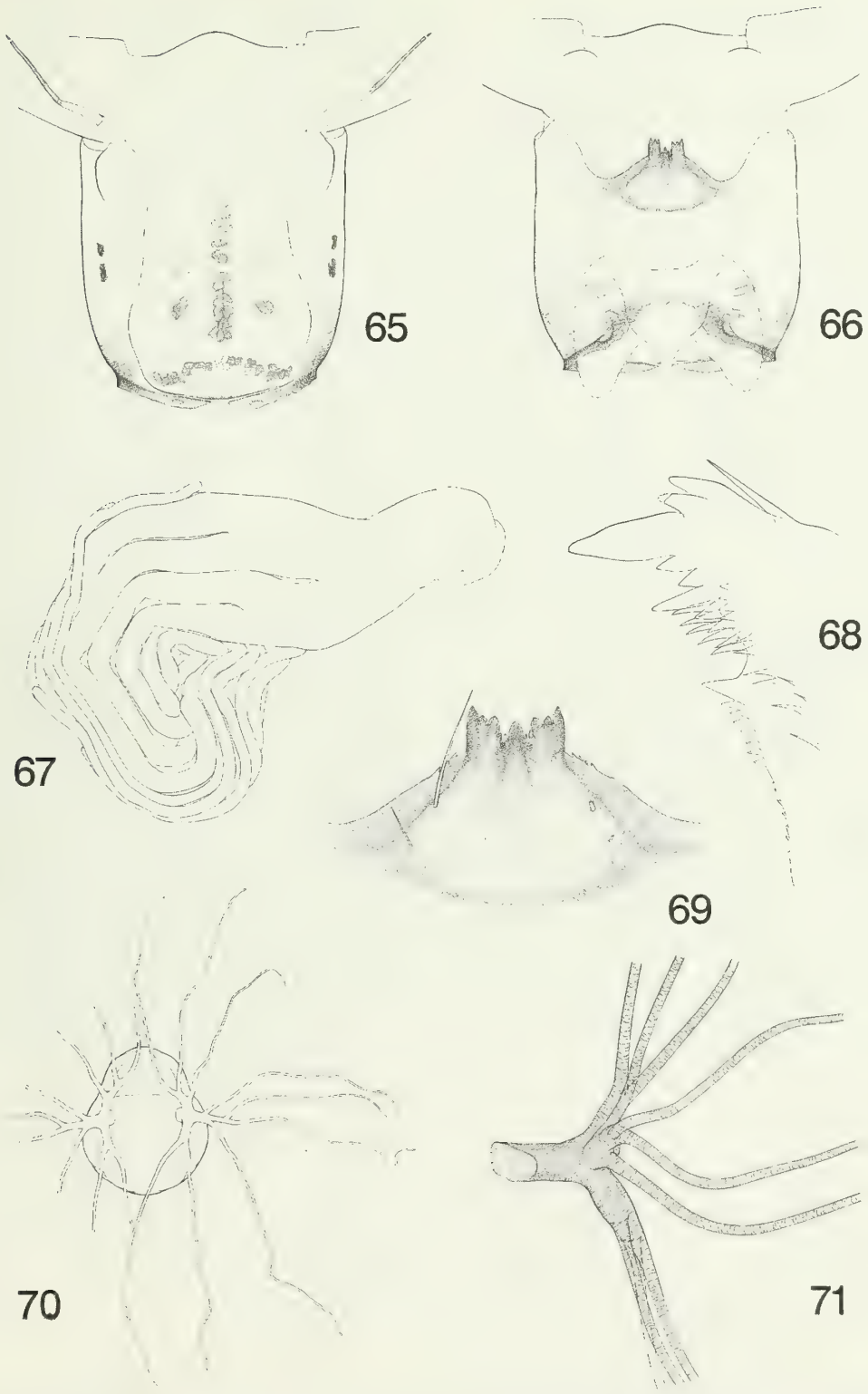
Figs. 37-46. *Prosimulium* (*Helodon*) *onychodactylum*. 37. Head of female. 38. Palpus of female. 39. Sensory vesicle of female, enlarged. 40. Proximal end of female cibarium. 41. Tip of blade of maxilla of female. 42. Tip of female mandible. 43. Hind, mid-, and fore legs of female. 44. Claw of female. 45. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) dorsal (inner) view of left gonostylus. 46. Terminalia of female: a) ventral view; b) lateral view of cercus and anal lobe.



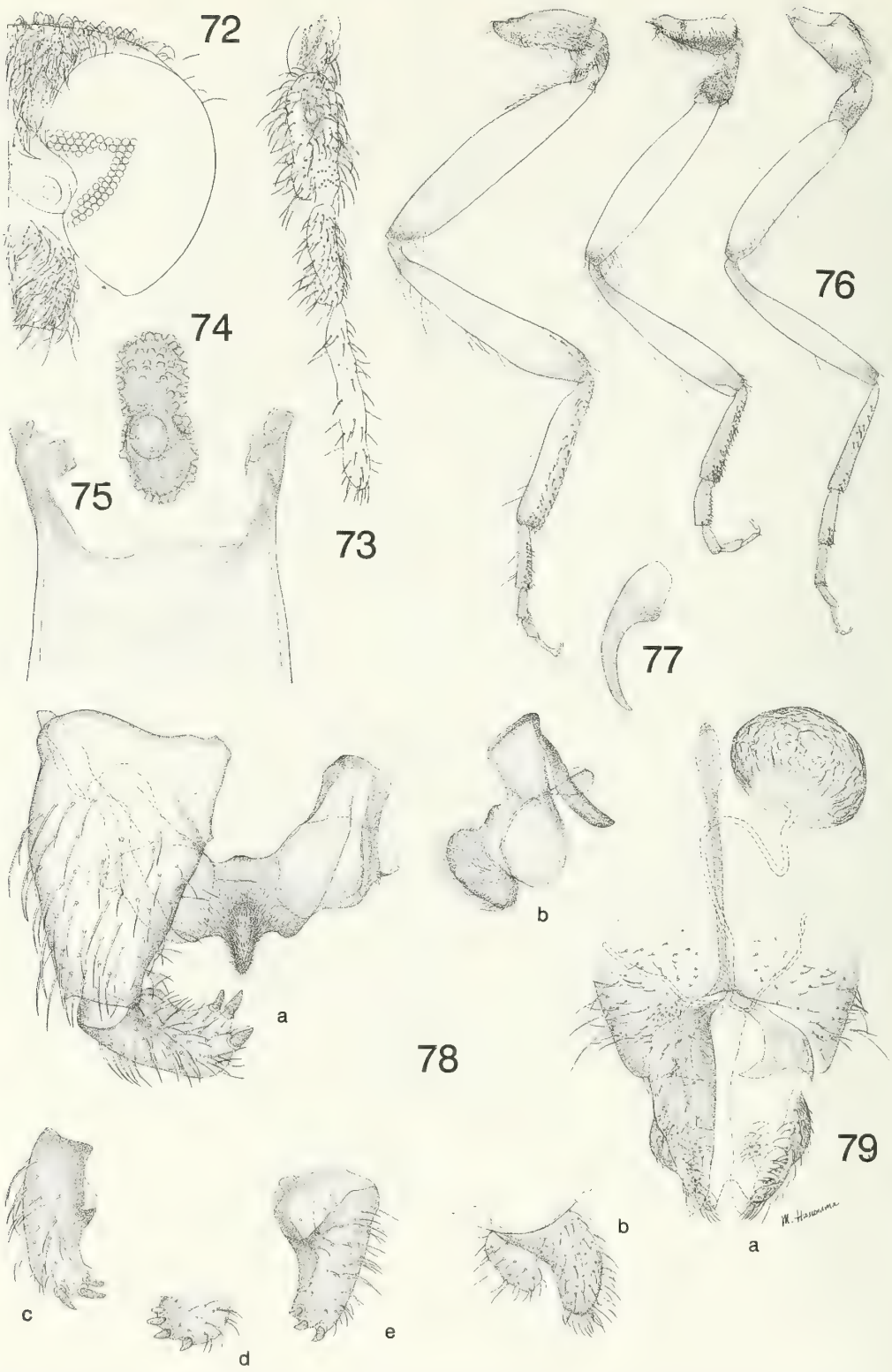
Figs, 47-52. *Prosimulium* (*Helodon*) *onychodactylum*. 47. Head capsule of larva, dorsal view. 48. Head capsule of larva, ventral view. 49. Respiratory histoblast of mature larva. 50. Tip of larval mandible. 51. Hypostoma of larva. 52. Pupal respiratory organ. Abbreviations: eyesp, eye spot; gn, gena; hyps brg, hypostomal bridge; hyps tth, hypostomal teeth; suboes gang; suboesophageal ganglion.



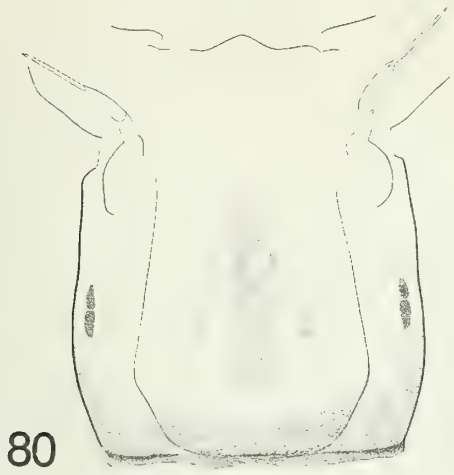
Figs. 53-64. *Prosimulium* (*Parahelodon*) *decemarticulatum*. 53. Head of female. 54. Palpus of female. 55. Sensory vesicle of female, enlarged. 56. Antenna of female. 57. Proximal end of female cibarium. 58. Tip of female mandible. 59. Tip of blade of maxilla of female. 60. Hind, mid-, and fore legs of female. 61. Tip of hind basitarsus and adjoining tarsomere of female. 62. Claw of female. 63. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d. ventral view of gonostylus; e. inner view of left gonostylus. 64. Terminalia of female: a) ventral view; b) lateral view.

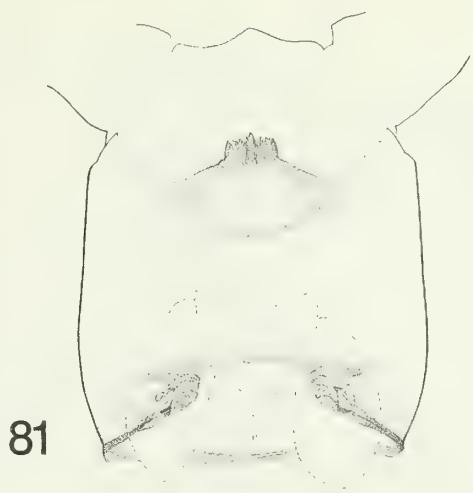


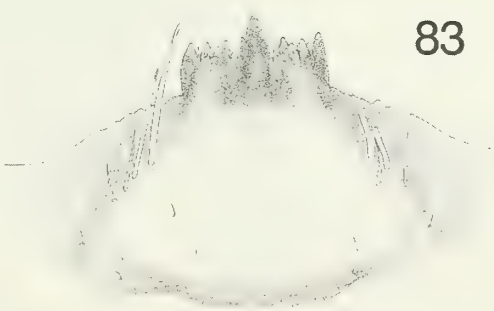
Figs. 65-71. *Prosimulium* (*Parahelodon*) *decemarticulatum*. 65. Head capsule of larva, dorsal view. 66. Head capsule of larva, ventral view. 67. Respiratory histoblast of mature larva. 68. Tip of larval mandible. 69. Hypostoma of larva. 70. Pupal respiratory organs, terminal (end) view. 71. Basal portion of pupal respiratory organ.



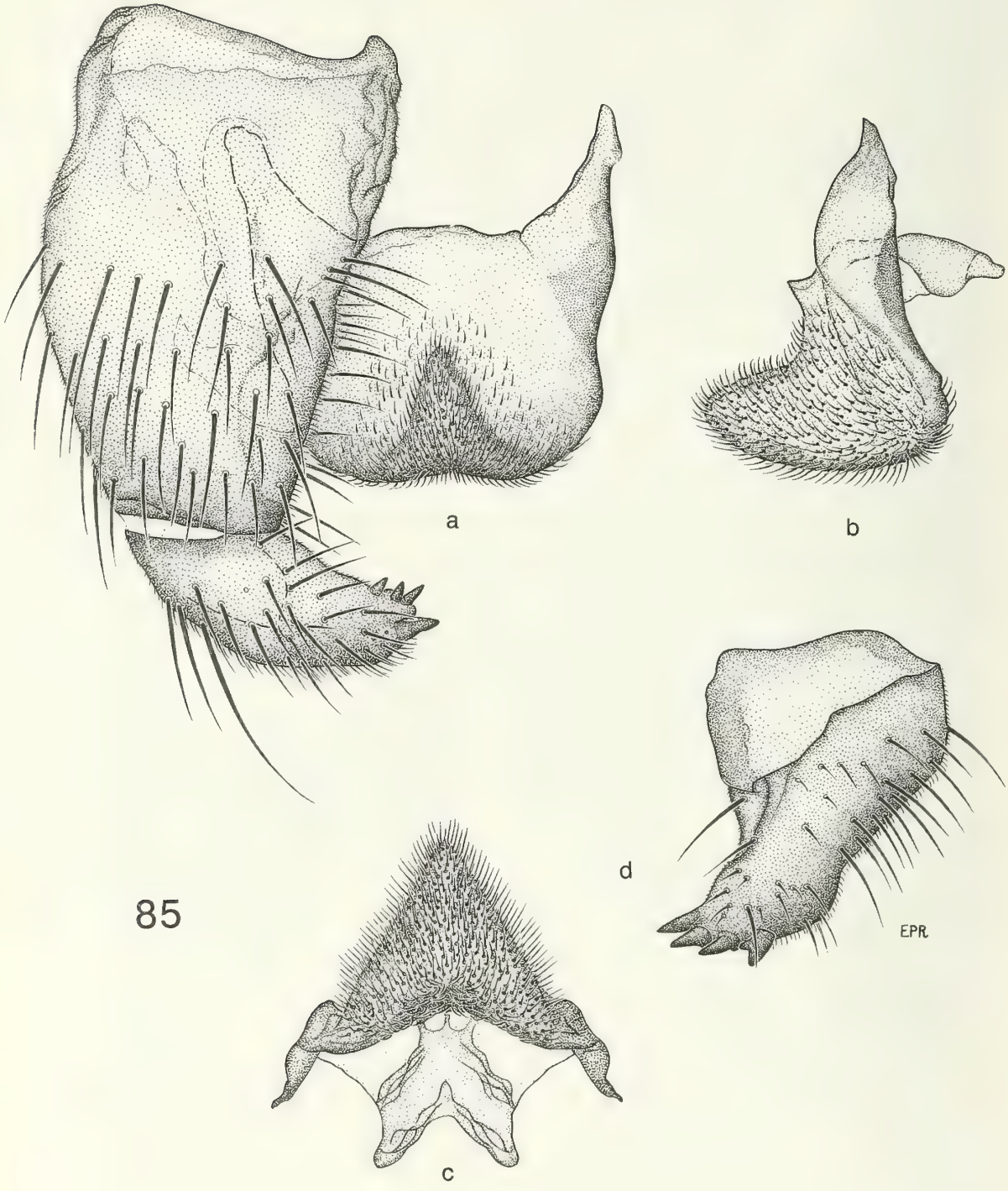
Figs. 72-79. *Prosimulium* (*Prosimulium*) *exigens*. 72. Head of female. 73. Palpus of female. 74. Sensory vesicle of female, enlarged. 75. Proximal end of female cibarium. 76. Hind, mid-, and forelegs of female. 77. Claw of female. 78. Terminalia of male: a) ventral view; b) lateral view; c) lateral view of gonostylus; d) tip of gonostylus; e) inner view of left gonostylus. 79. Terminalia of female: a) ventral view; b) lateral view.







Figs. 80-84. *Prosimulium* (*Prosimulium*) *exigens*. 80. Head capsule of larva, dorsal view. 81. Head capsule of larva, ventral view. 82. Tip of larval mandible. 83. Hypostoma of larva. 84. Pupal respiratory organ.



Figs. 85. *Prosimulium* (*Prosimulium*) *flaviantennum* male. 85. Terminalia: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus.

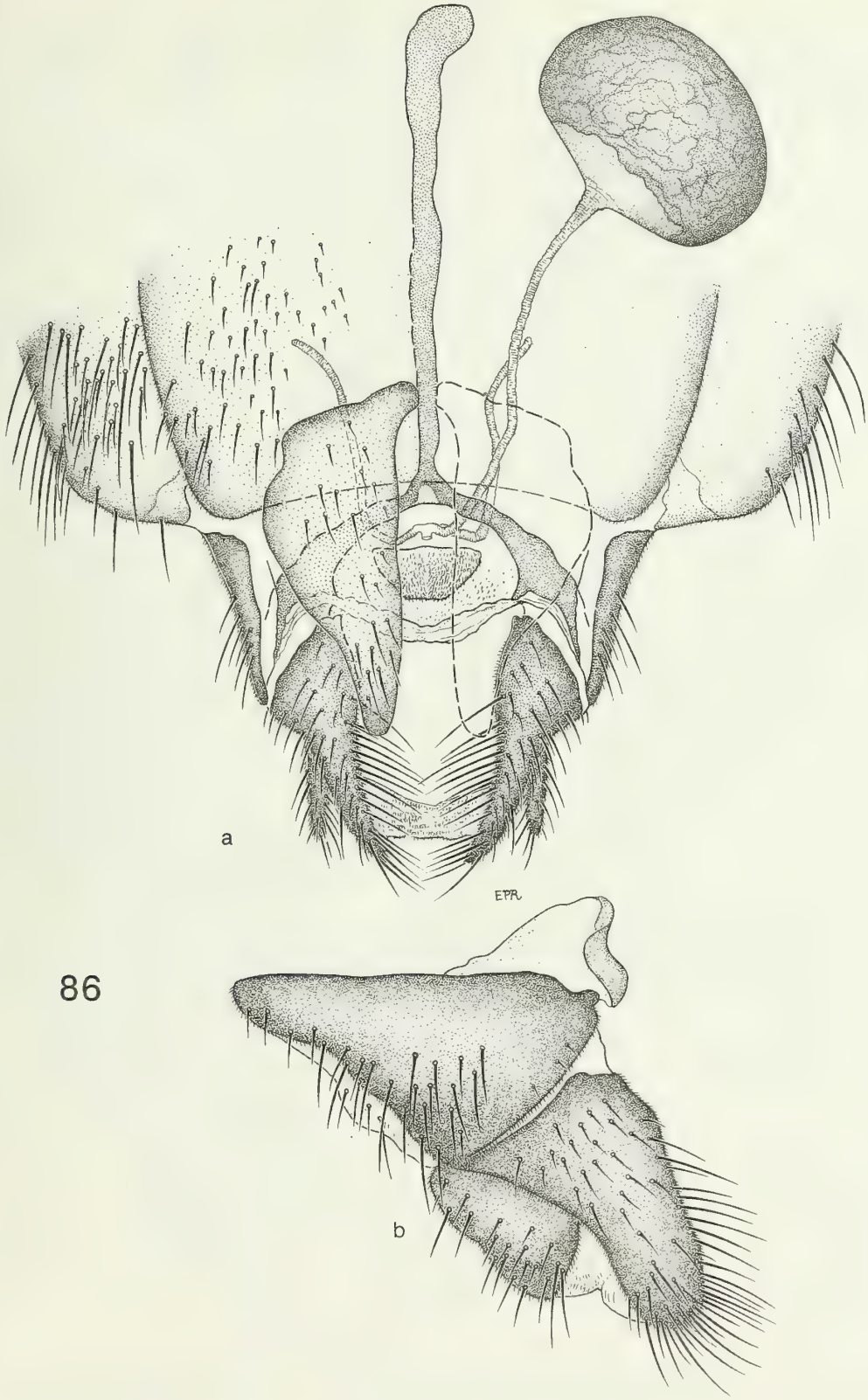
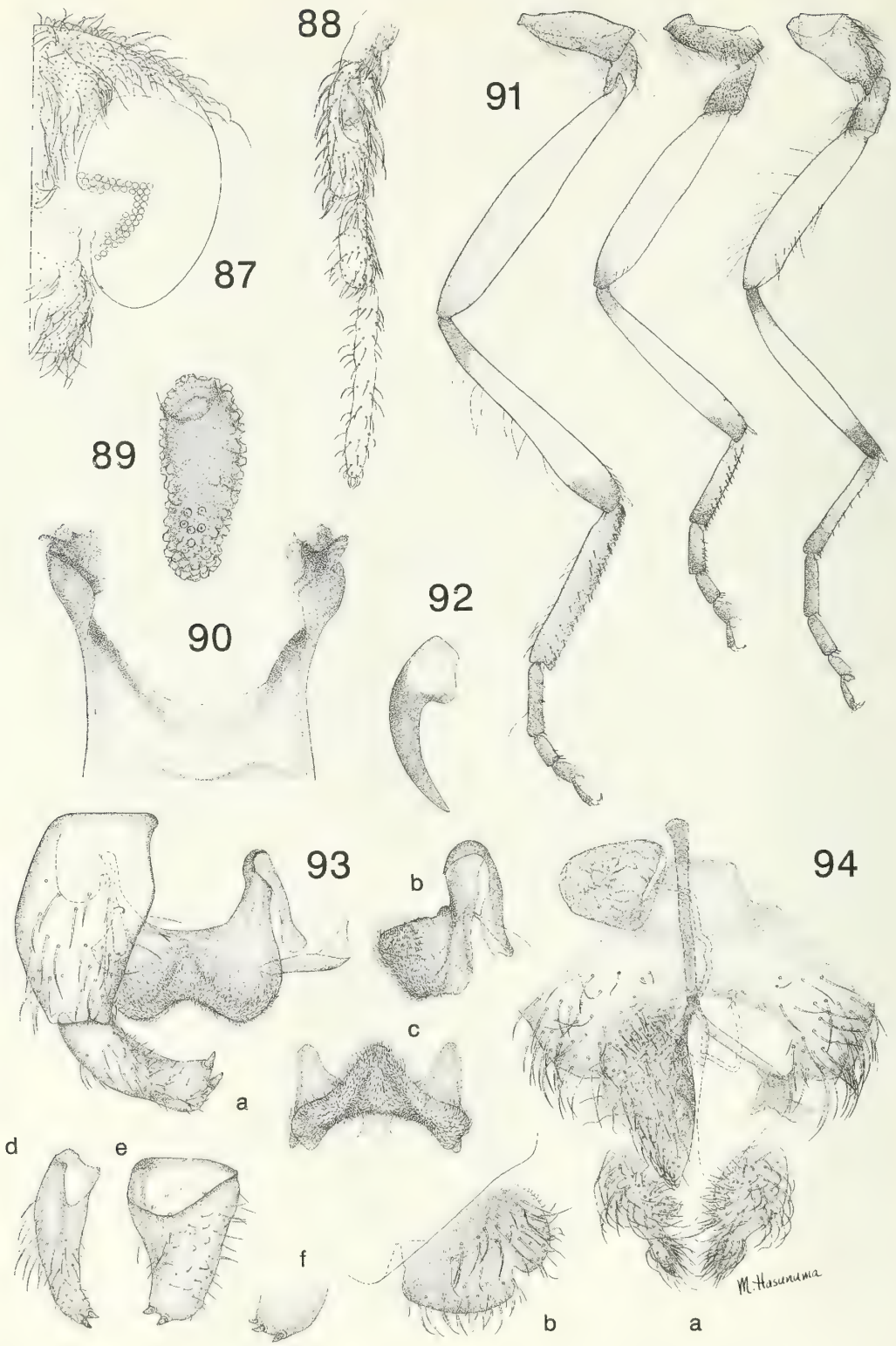
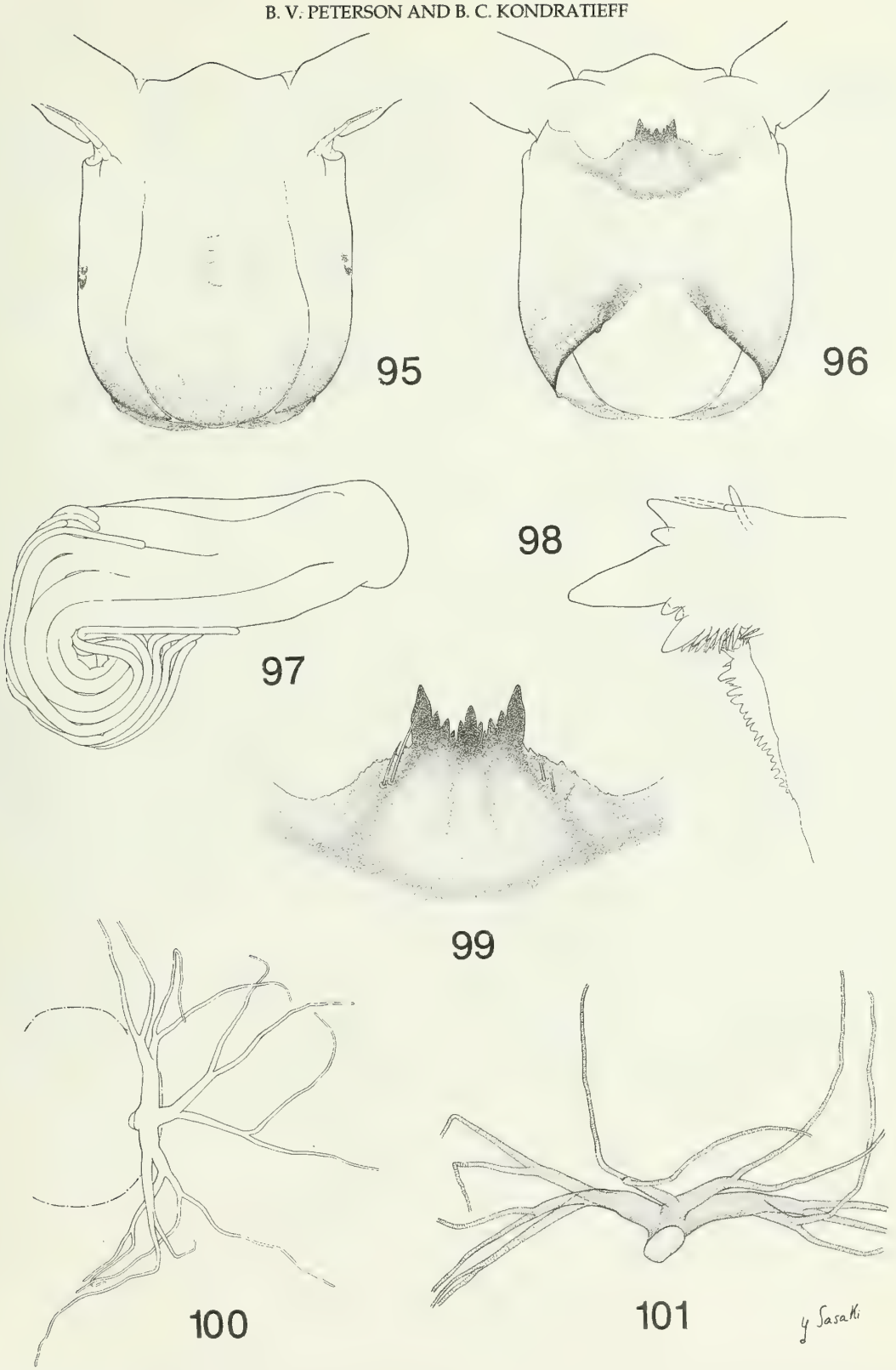


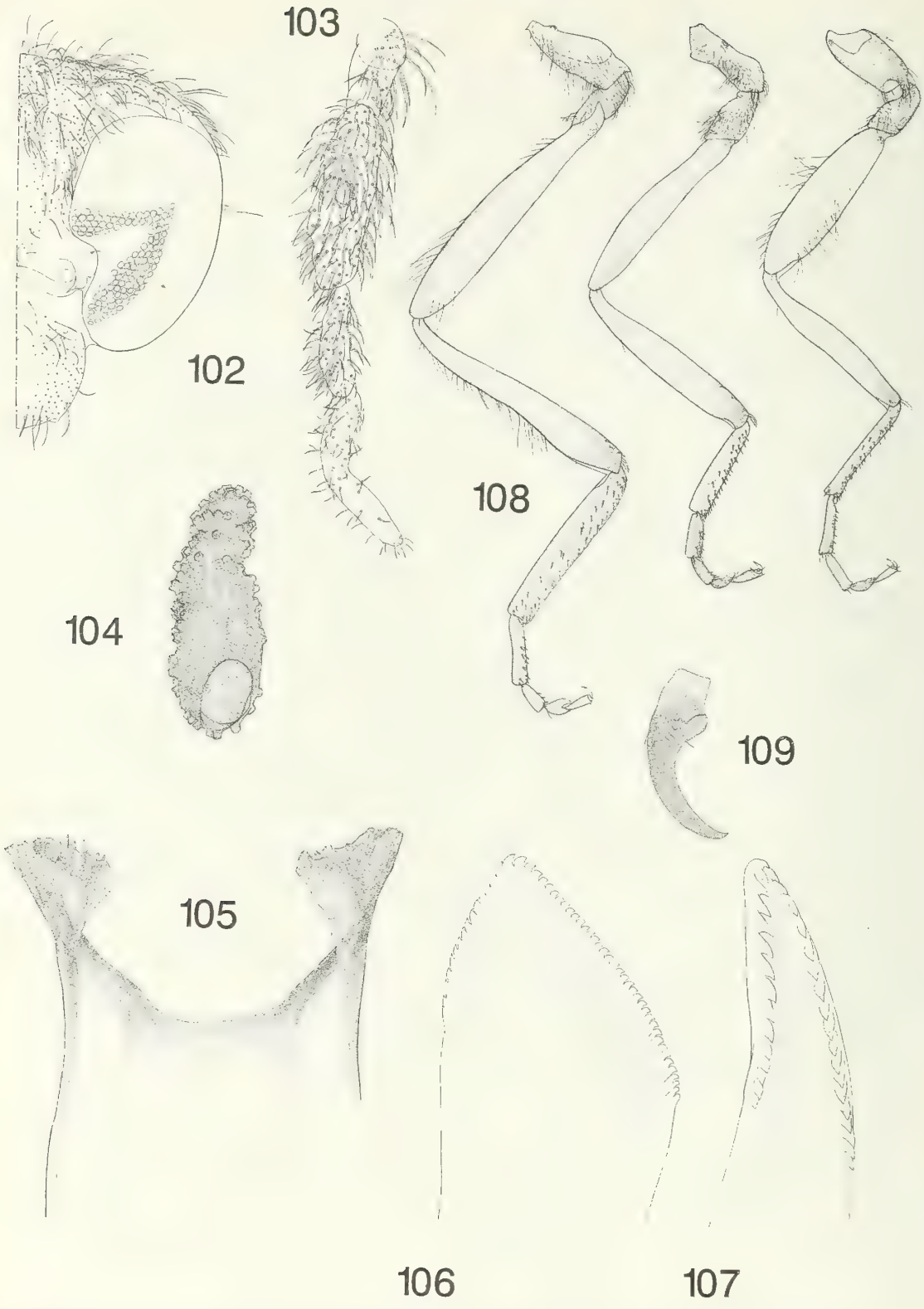
Fig. 86. *Prosimulium* (*Prosimulium*) *flaviantennum* female. 86. Terminalia: a) ventral view; b) lateral view.



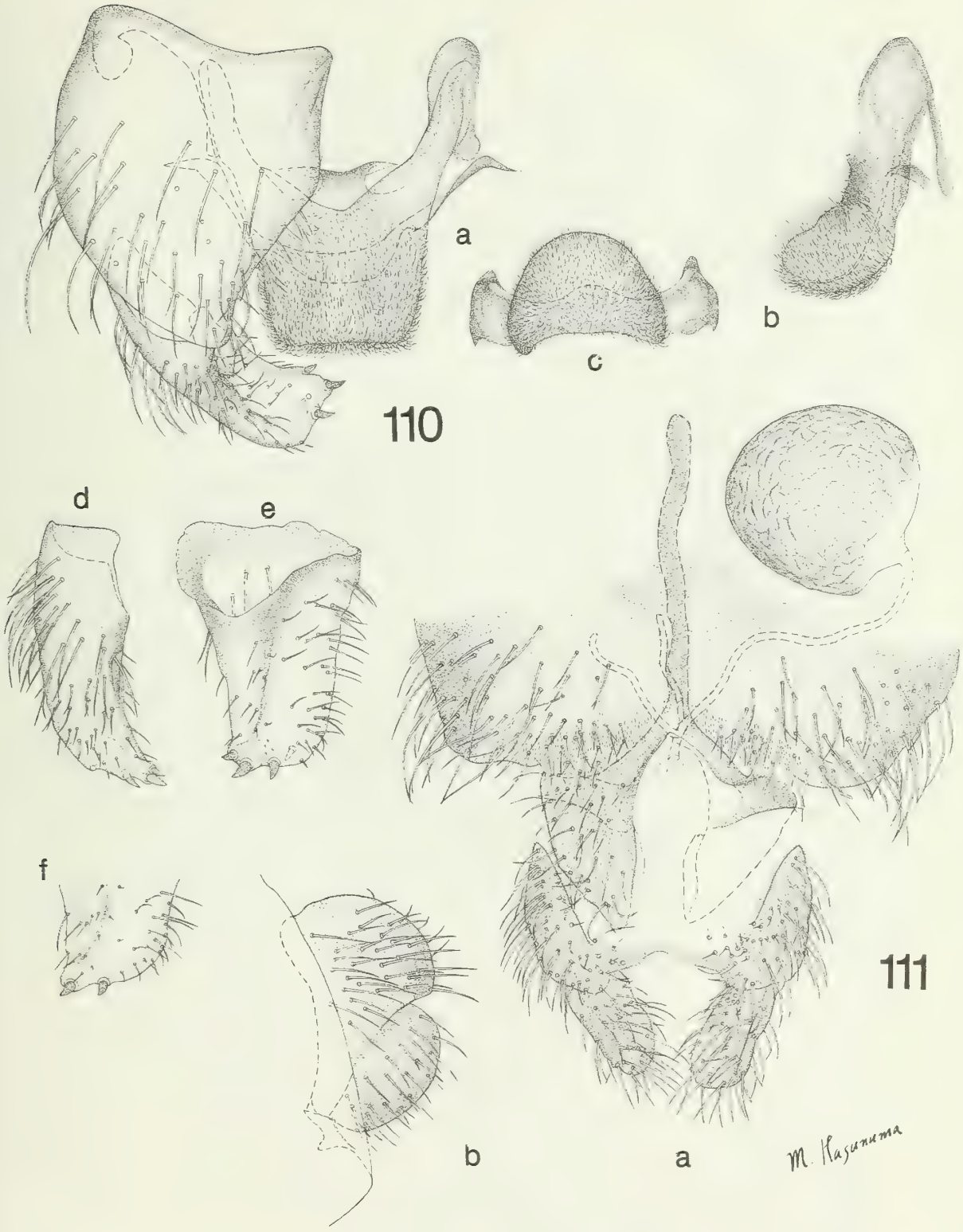
Figs. 87-94. *Prosimulium* (*Prosimulium*) *frohnei*. 87. Head of female. 88. Palpus of female. 89. Sensory vesicle of female, enlarged. 90. Proximal end of female cibarium. 91. Hind, mid-, and forelegs of female. 92. Claw of female. 93. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) ventrolateral view of gonostylus; e) inner view of left gonostylus; f) tip of gonostylus. 94. Terminalia of female: a) ventral view; b) lateral view.



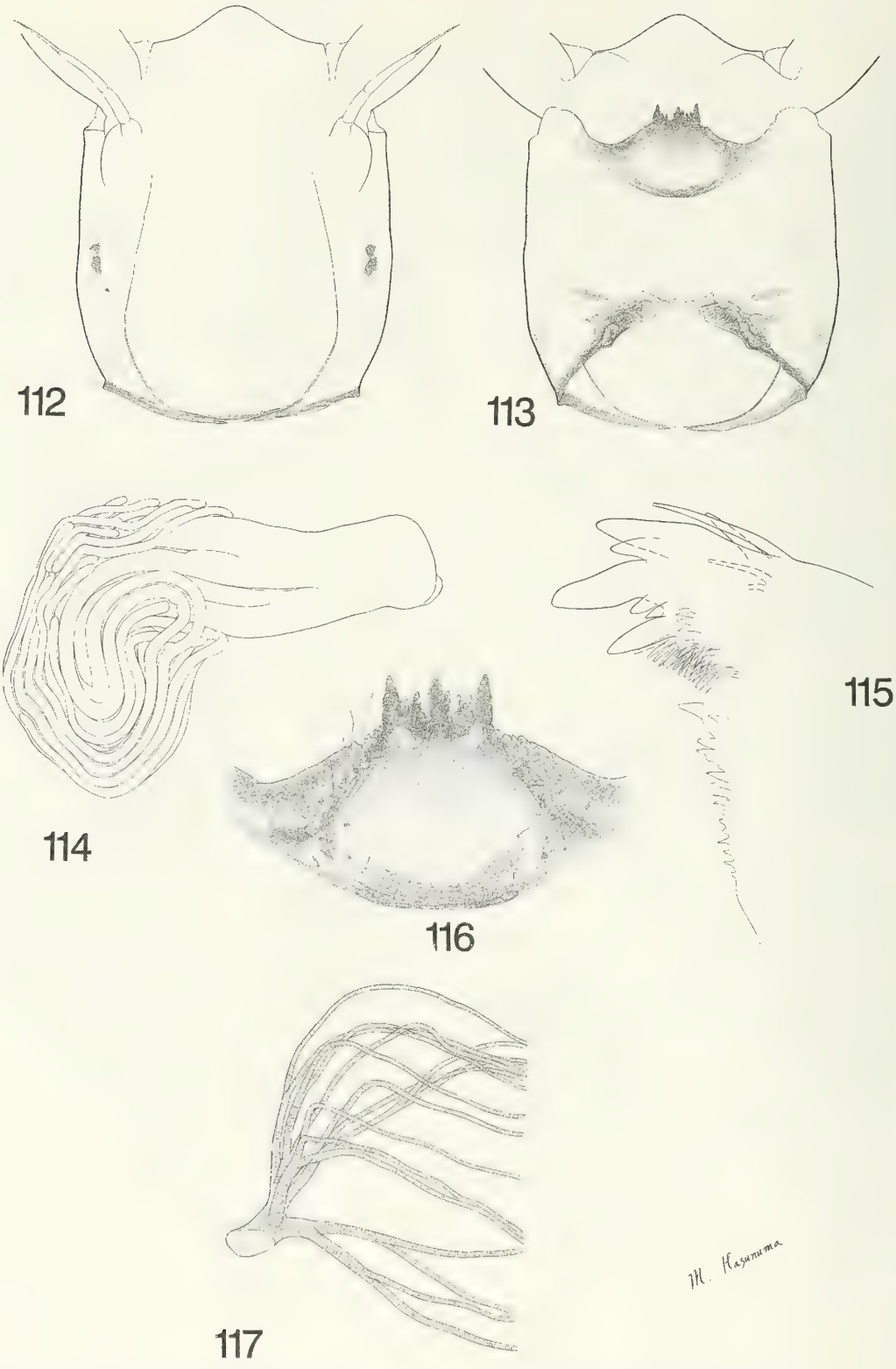
Figs. 95-101. *Prosimulium* (*Prosimulium*) *frohnei*. 95. Head capsule of larva, dorsal view. 96. Head capsule of larva, ventral view. 97. Respiratory histoblast of mature larva. 98. Tip of larval mandible. 99. Hypostoma of larva. 100. Pupal respiratory organ, terminal (end) view. 101. Basal portion of pupal respiratory organ.



Figs. 102-109. *Prosimulium* (*Prosimulium*) *fulvum*. 102. Head of female. 103. Palpus of female. 104. Sensory vesicle of female, enlarged. 105. Proximal end of female cibarium. 106. Mandible of female. 107. Blade of female maxilla. 108. Hind, mid-, and forelegs of female. 109. Claw of female.



Figs. 110-111. *Prosimulium* (*Prosimulium*) *fulvum*. 110. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus; f) tip of gonostylus. 111. Terminalia of female: a) ventral view; b) lateral view.



Figs. 112-117. *Prosimulium* (*Prosimulium*) *fulvum*. 112. Head capsule of larva, dorsal view. 113. Head capsule of larva, ventral view. 114. Respiratory histoblast of mature larva. 115. Tip of larval mandible. 116. Hypostoma of larva. 117. Pupal respiratory organ.

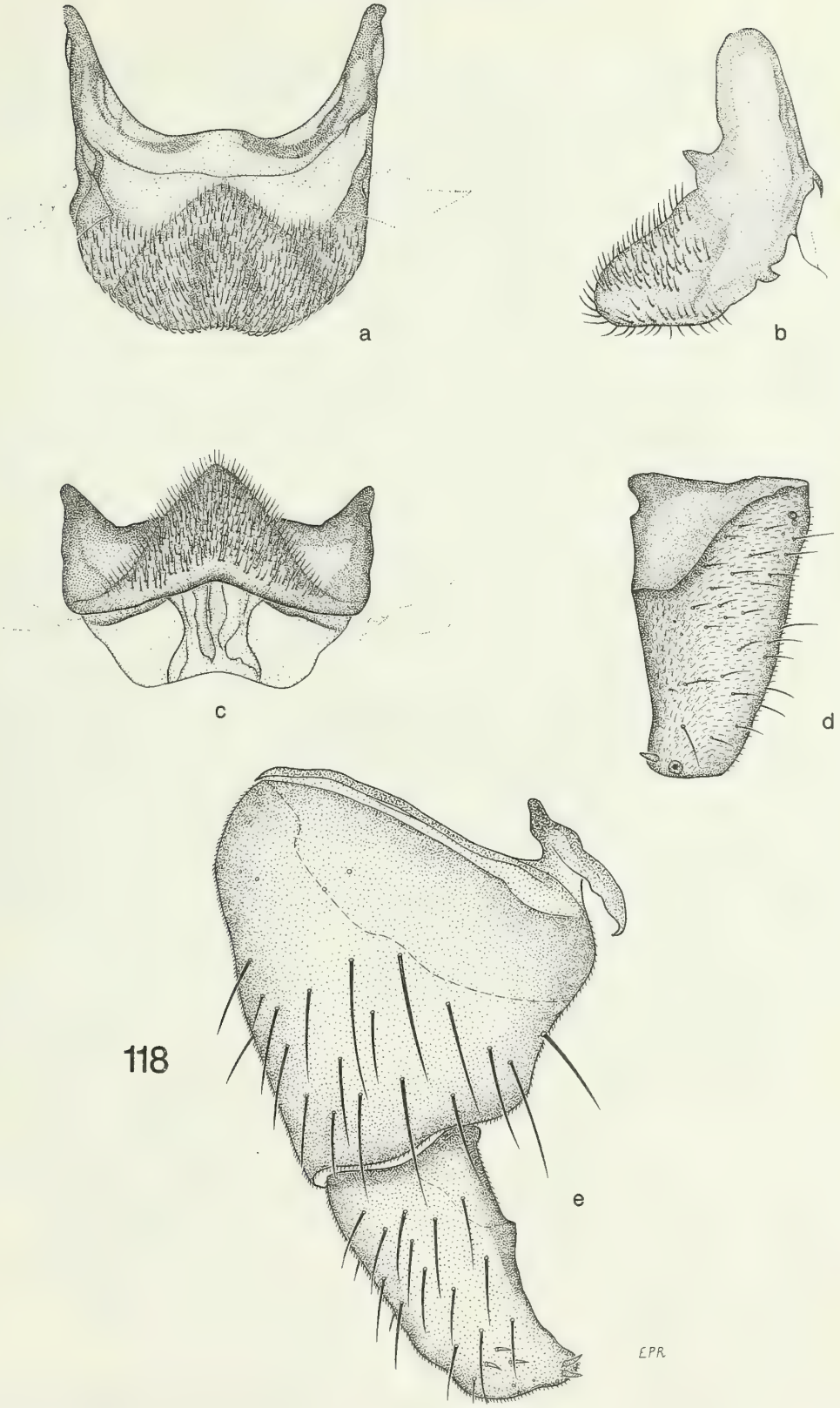
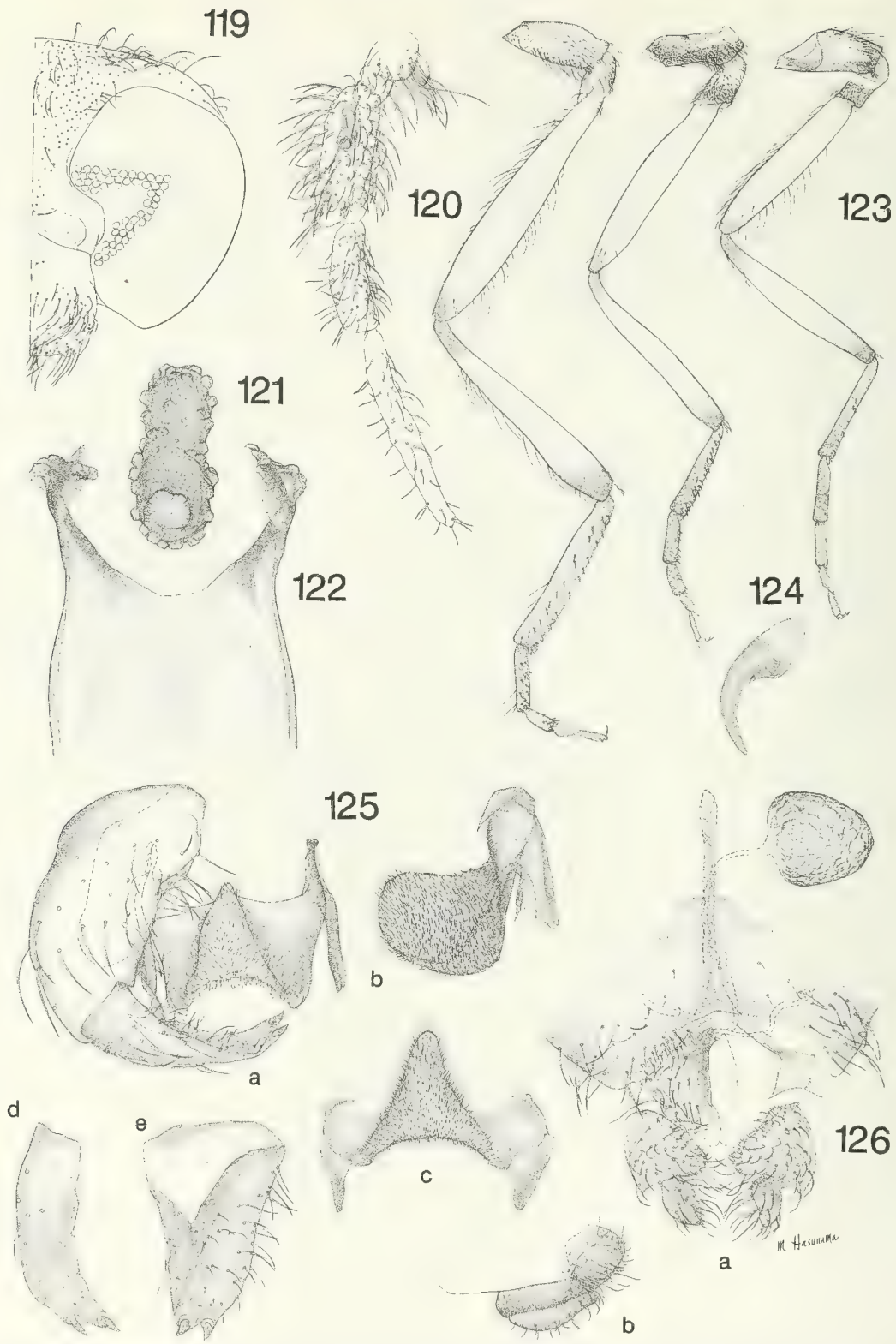
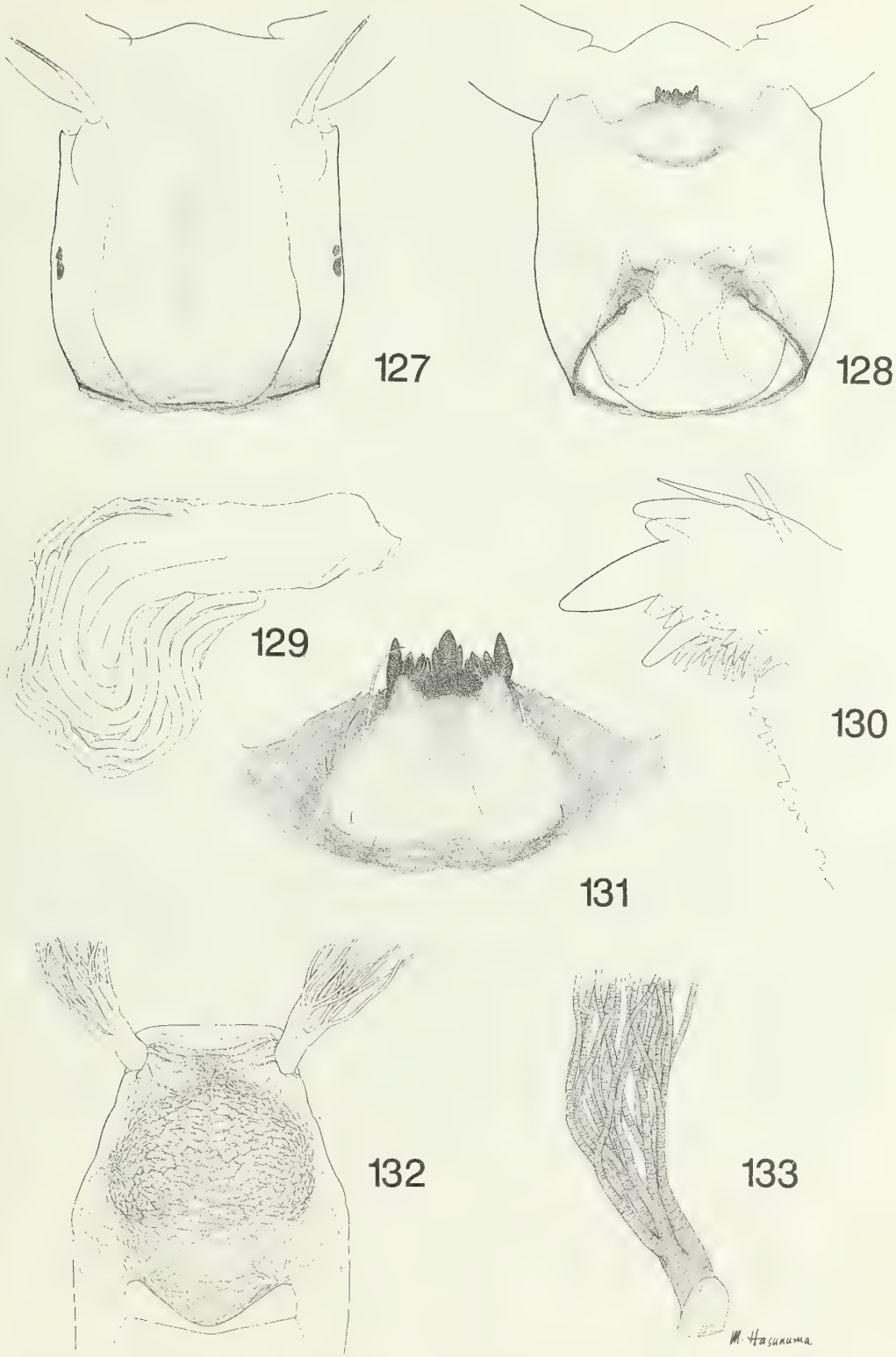


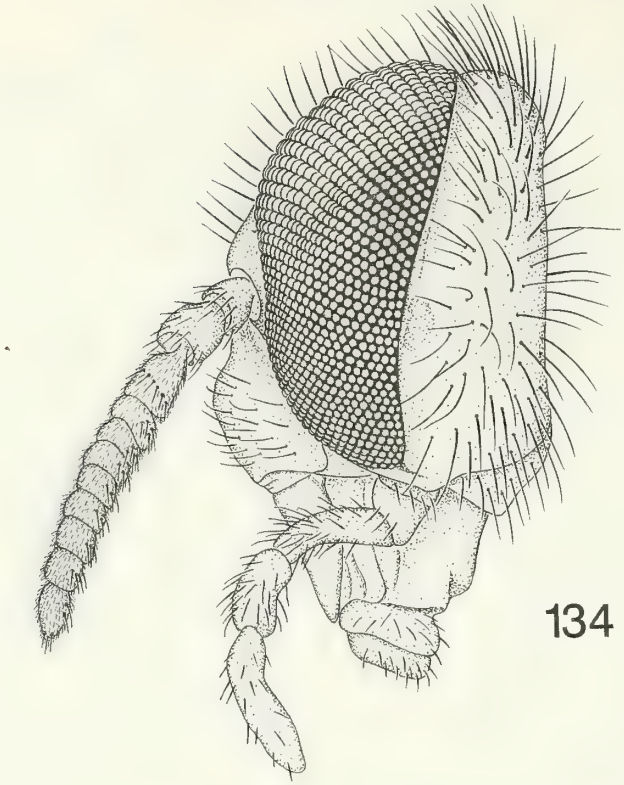
Fig. 118. *Prosimulium* (*Prosimulium*) *opleri* male. 118. Terminalia: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus; e) lateral view of gonocoxite and gonostylus.

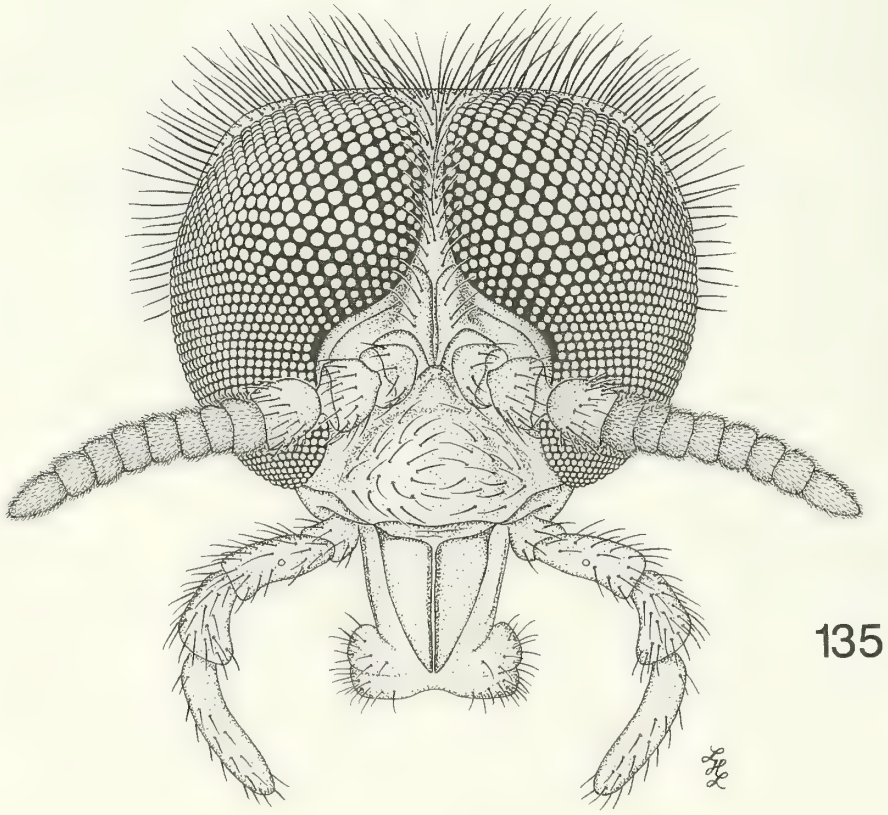


Figs. 119-126. *Prosimulium* (*Prosimulium*) *travisi*. 119. Head of female. 120. Palpus of female. 121. Sensory vesicle of female, enlarged. 122. Proximal end of female cibarium. 123. Hind, mid-, and forelegs of female. 124. Claw of female. 125. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 126. Terminalia of female: a) ventral view; b) lateral view.

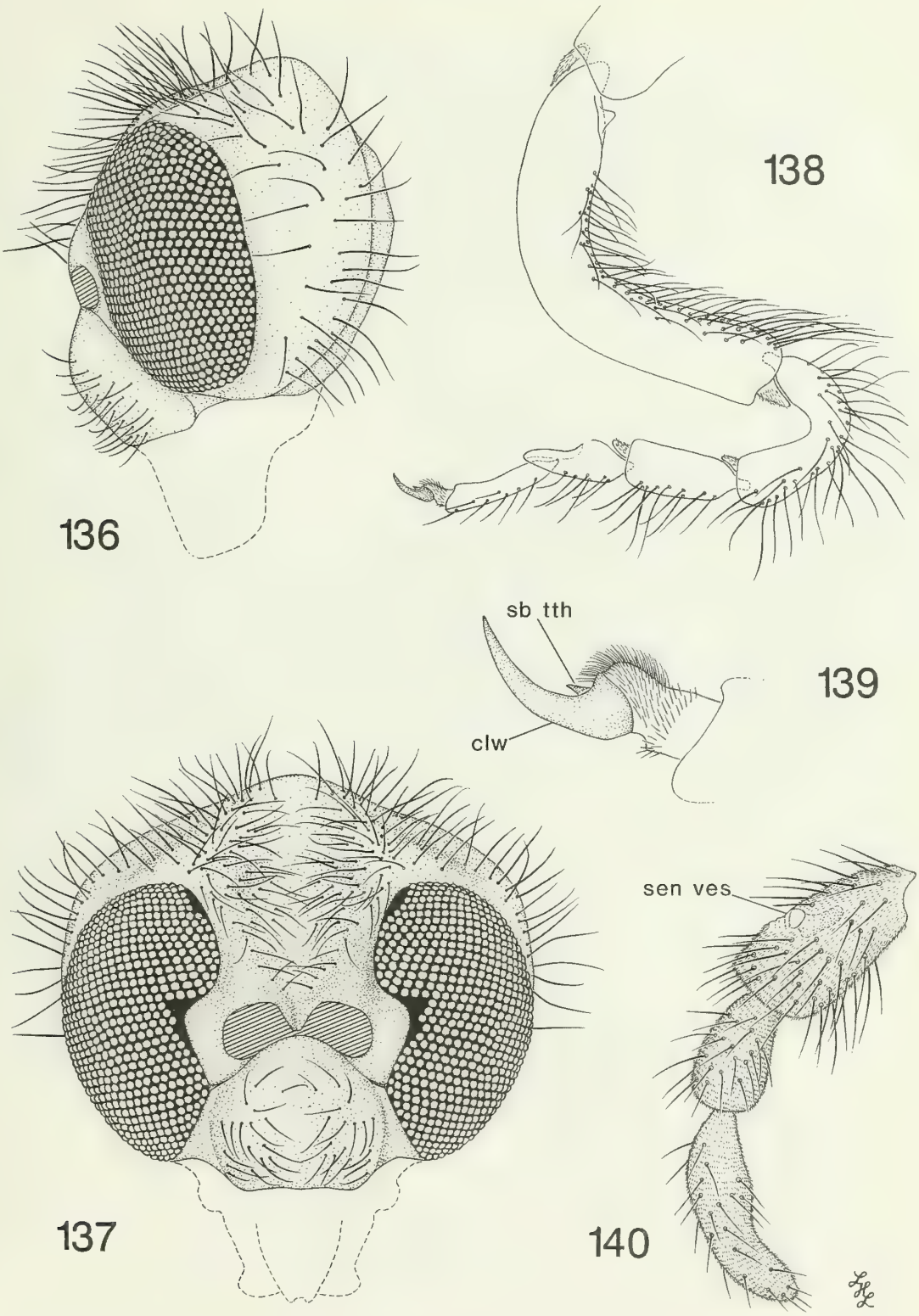


Figs. 127-133. *Prosimulium* (*Prosimulium*) *travisi*. 127. Head capsule of larva, dorsal view. 128. Head capsule of larva, ventral view. 129. Respiratory histoblast of mature larva. 130. Tip of larval mandible. 131. Hypostoma of larva. 132. Pupal thorax, dorsal view. 133. Pupal respiratory organ.





Figs. 134-135. *Prosimulium* (*Prosimulium*) *wui*. 134. Male head, lateral view. 135. Male head, front view.



Figs. 136-140. *Prosimulium* (*Prosimulium*) *wui*. 136. Head of female, lateral view. 137. Head of female, front view. 138. Hind leg of female. 139. Claw of female. 140. Palpus of female. Abbreviations: clw, claw; sb tth, subbasal tooth; sen ves, sensory vesicle.

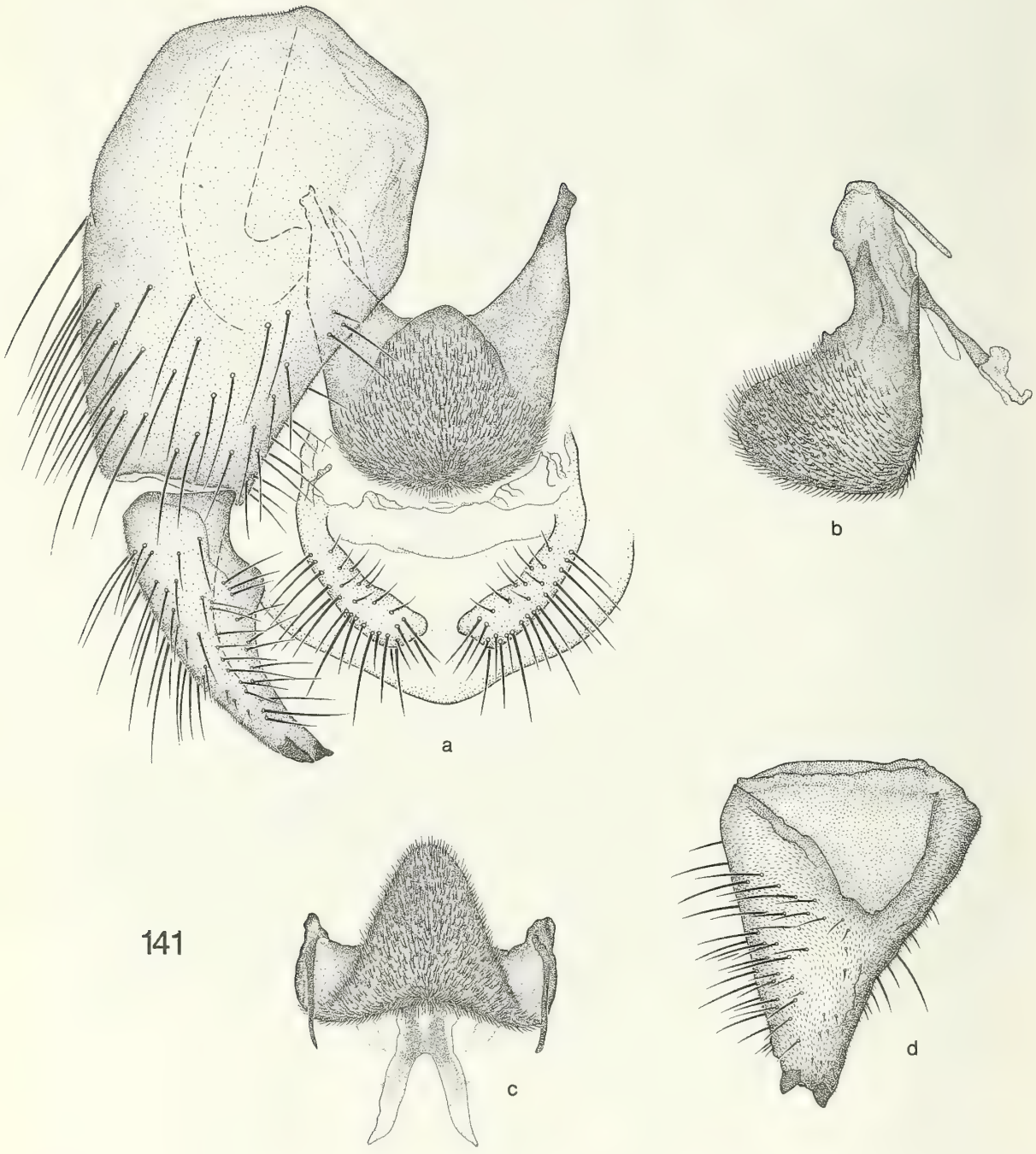
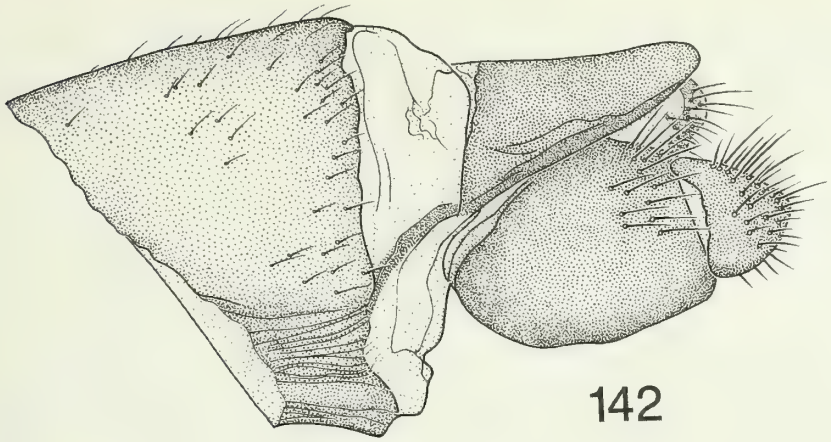


Fig. 141. *Prosimulium* (*Prosimulium*) *wui* male. 141. Terminalia: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus.



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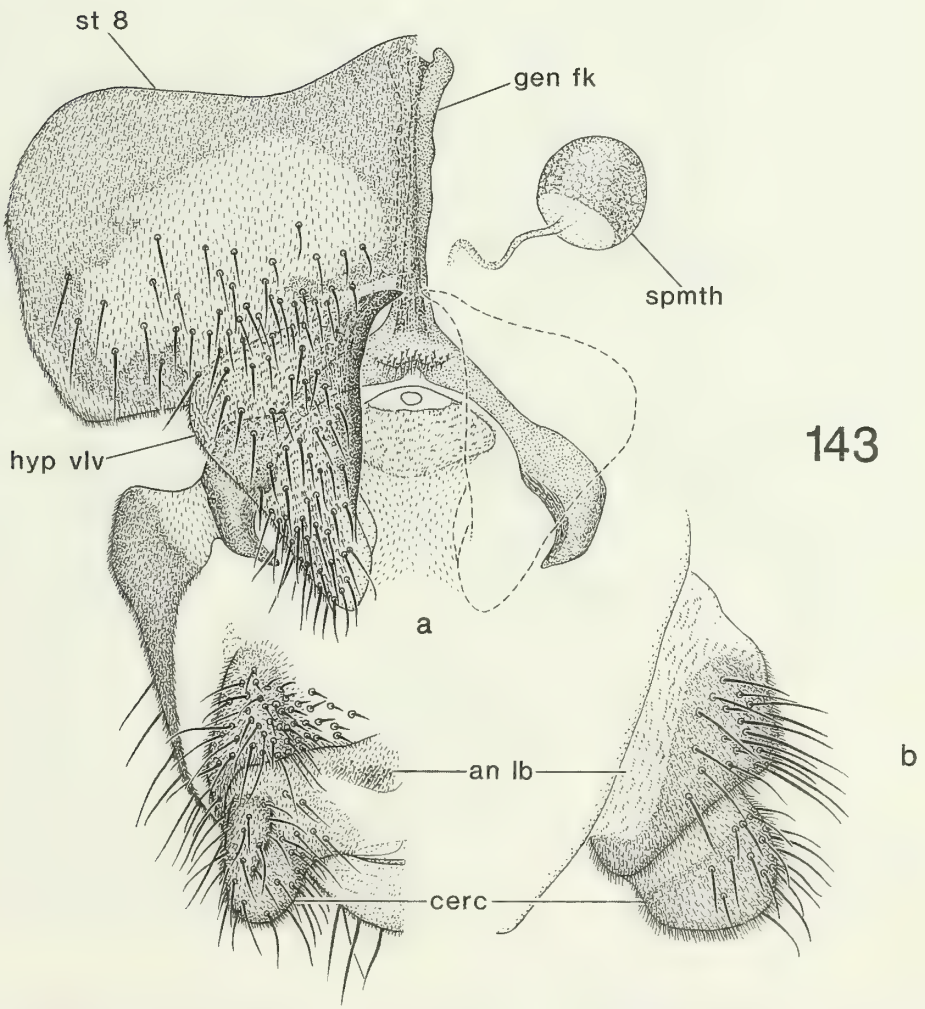
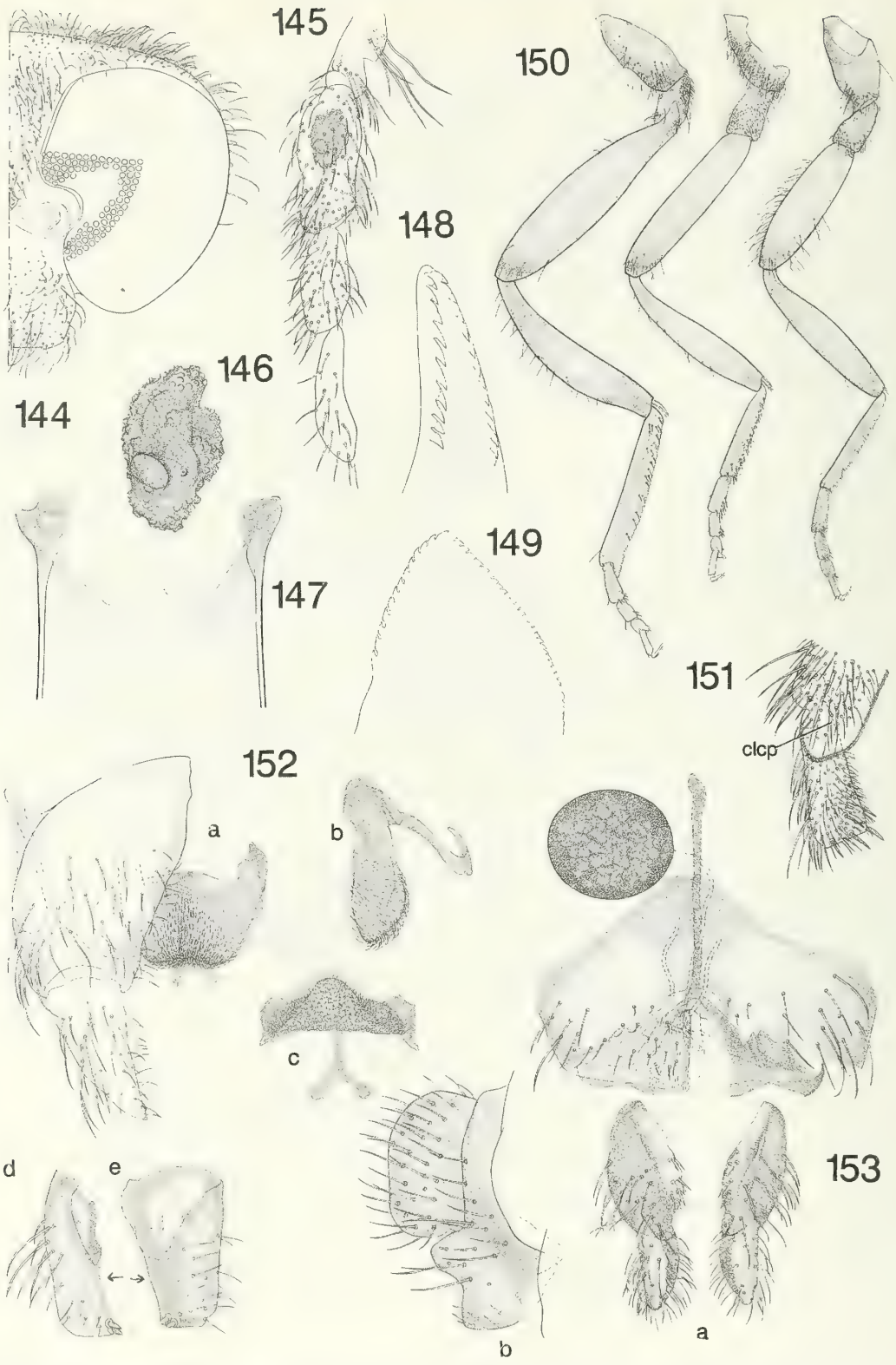
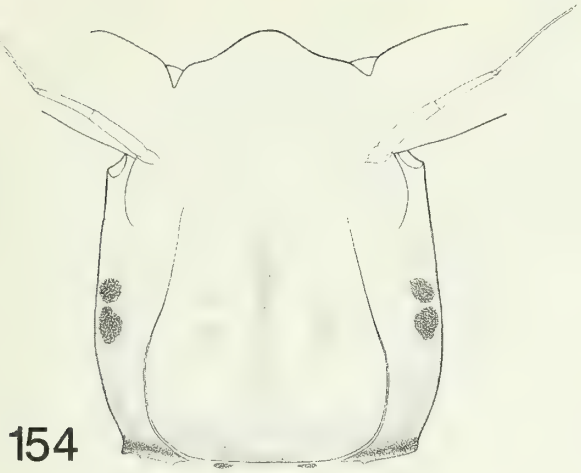
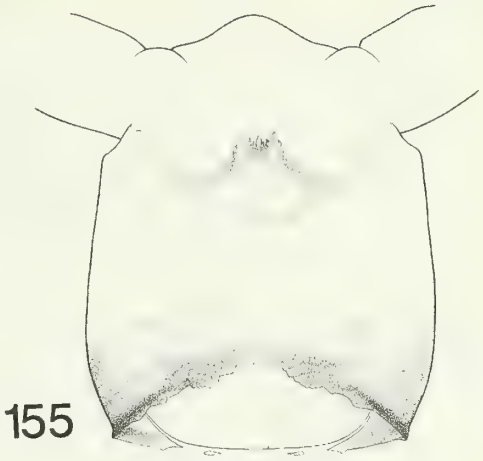


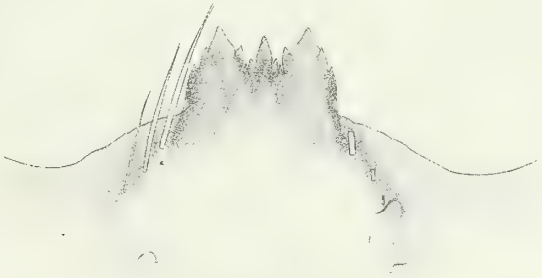
Figs. 142-143. *Prosimulium* (*Prosimulium*) *wui*. 142. Posterior portion of abdomen of male, lateral view. 143. Terminalia of female: a) ventral view; b) lateral view. Abbreviations: an lb, anal lobe; cerc, cercus; gen fk, genital fork; hyp vlv, hypogynial valve; spmth, spermatheca; st 8, sternite 8.

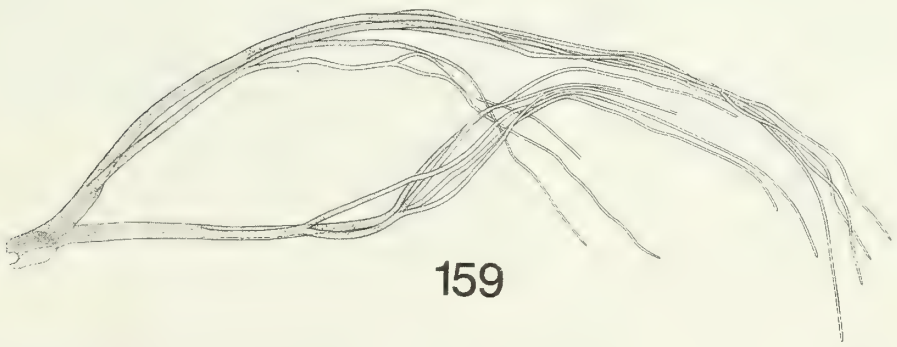


Figs. 144-153. *Stegopterna mutata*. 144. Head of female. 145. Palpus of female. 146. Sensory vesicle of female, enlarged. 147. Proximal end of female cibarium. 148. Tip of blade of female maxilla. 149. Tip of female mandible. 150. Hind, mid-, and forelegs of female. 151. Tip of hind basitarsus and second hind tarsomere. 152. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 153. Terminalia of female: a) ventral view; b) lateral view. Abbreviation: clcp, calcipala.

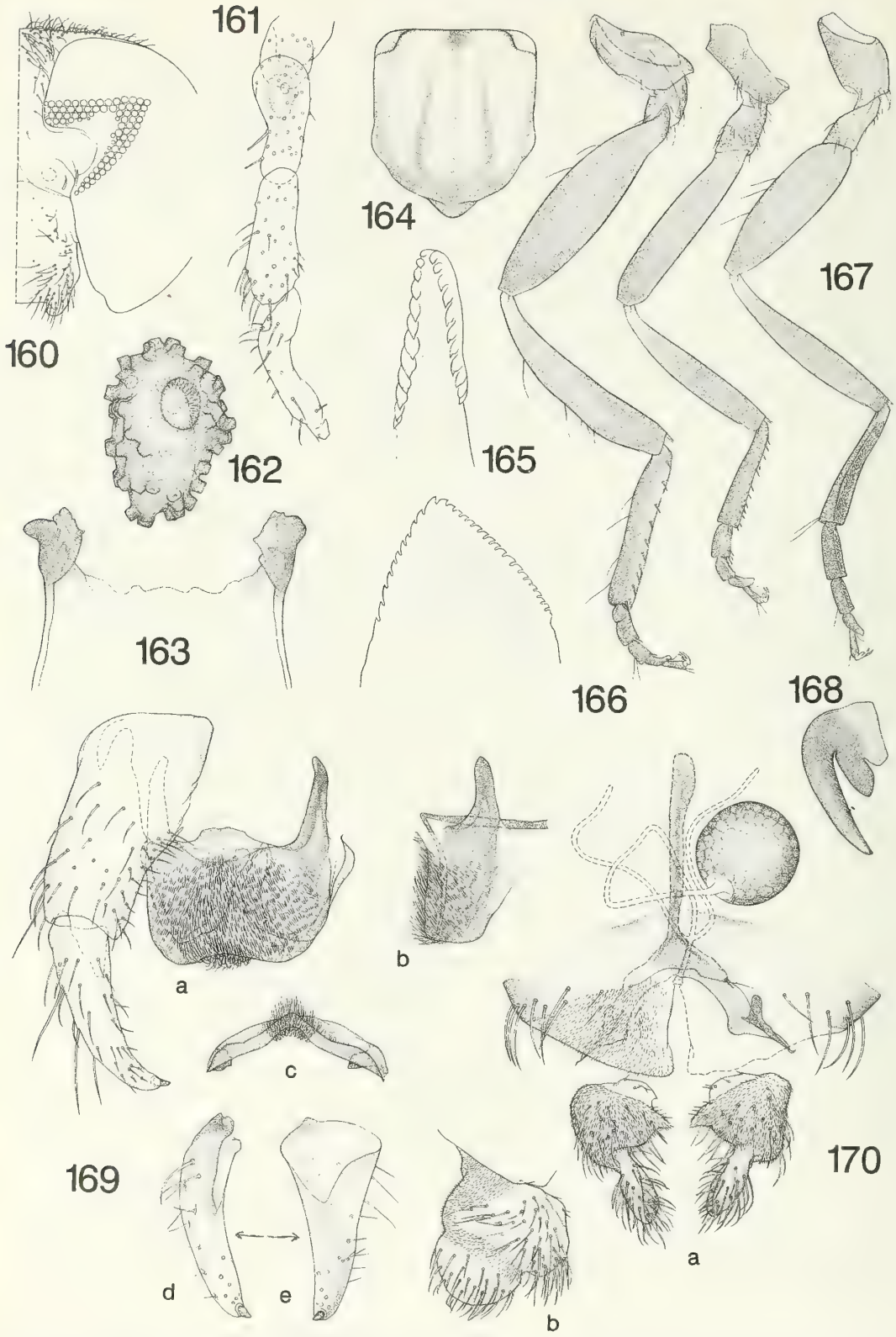




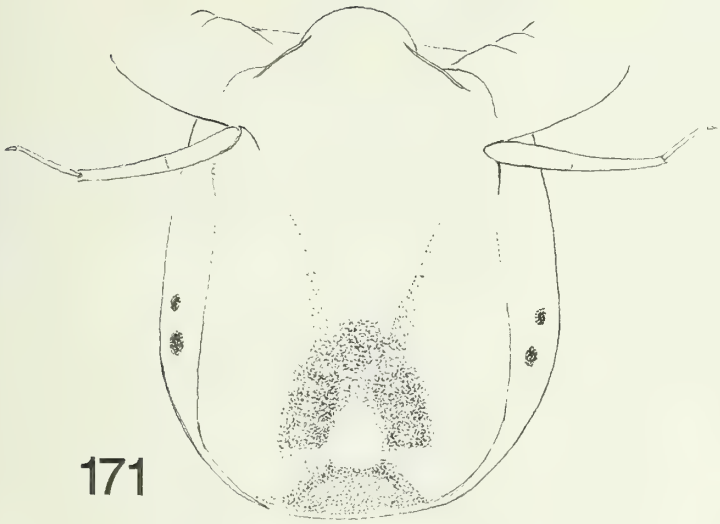


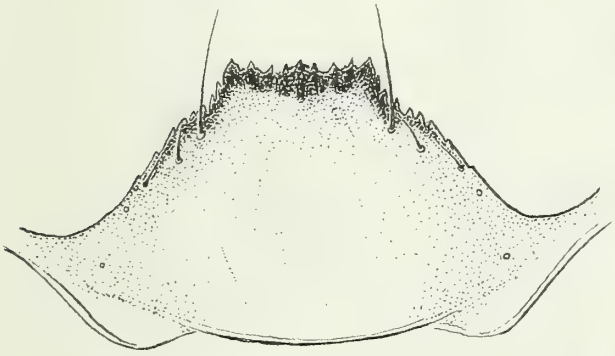


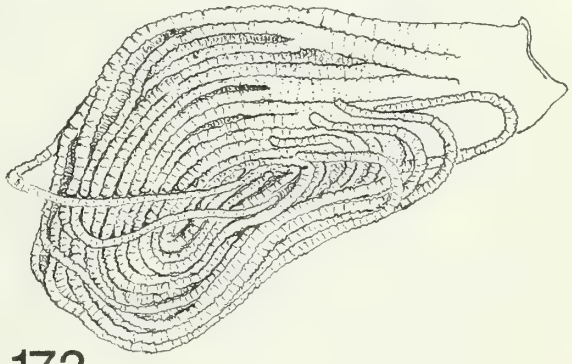
Figs. 154-159. *Stegopterna mutata*. 154. Head capsule of larva, dorsal view. 155. Head capsule of larva, ventral view. 156. Respiratory histoblast of mature larva. 157. Tip of larval mandible. 158. Hypostoma of larva. 159. Pupal respiratory organ.

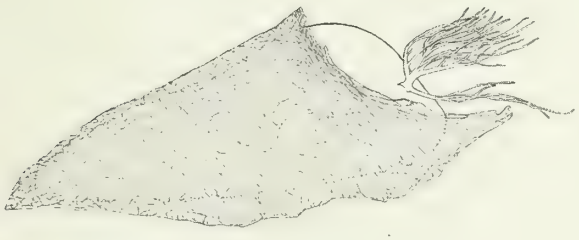


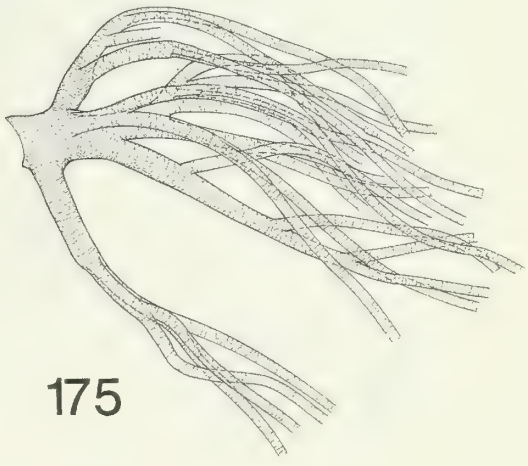
Figs. 160-170. *Simulium* (*Byssodon*) *meridionale*. 160. Head of female. 161. Palpus of female. 162. Sensory vesicle of female, enlarged. 163. Proximal end of female cibarium. 164. Female thorax, dorsal view. 165. Tip of blade of female maxilla. 166. Tip of female mandible. 167. Hind, mid-, and forelegs of female. 168. Claw of female. 169. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 170. Terminalia of female: a) ventral view; b) lateral view.



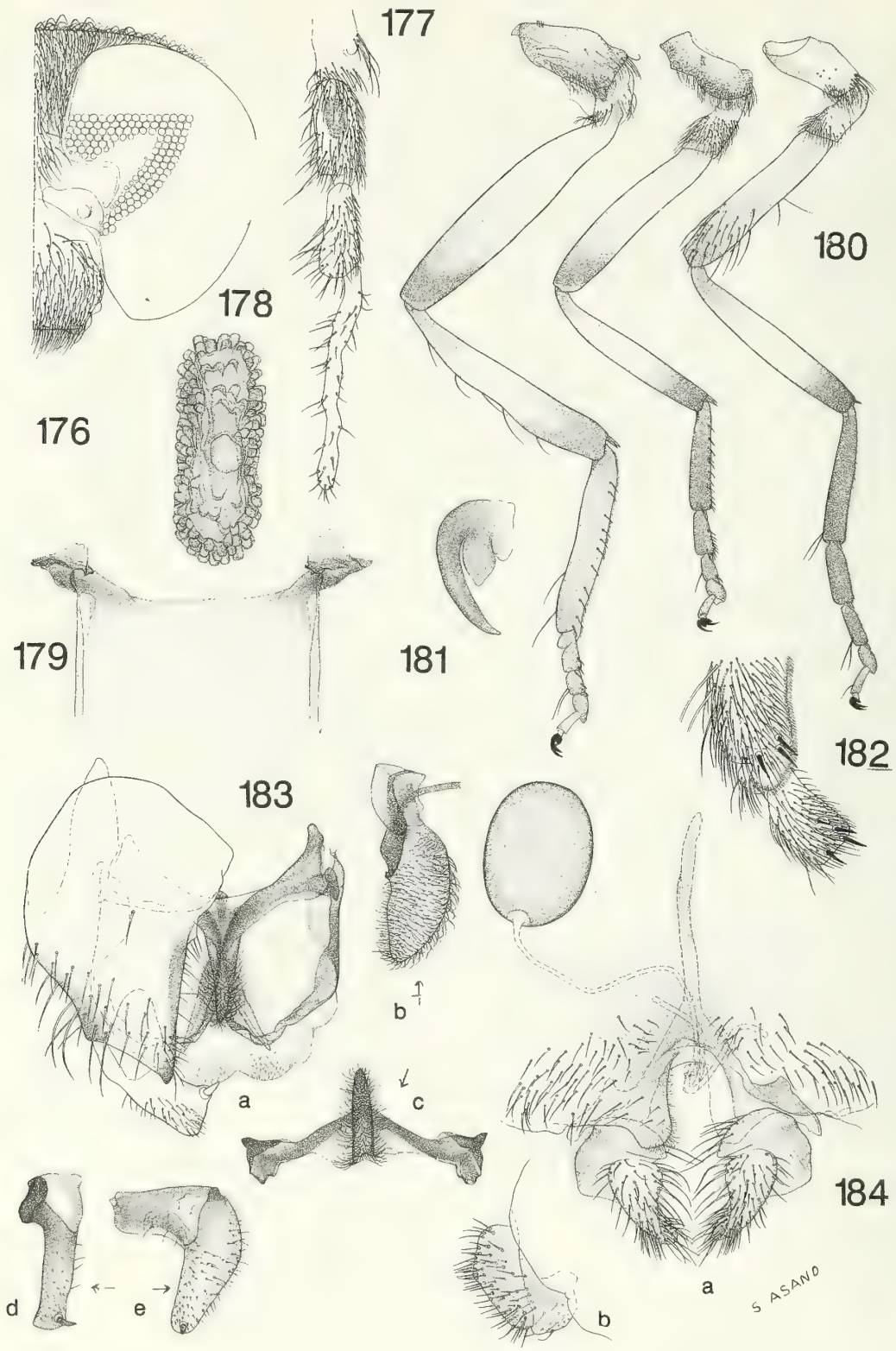




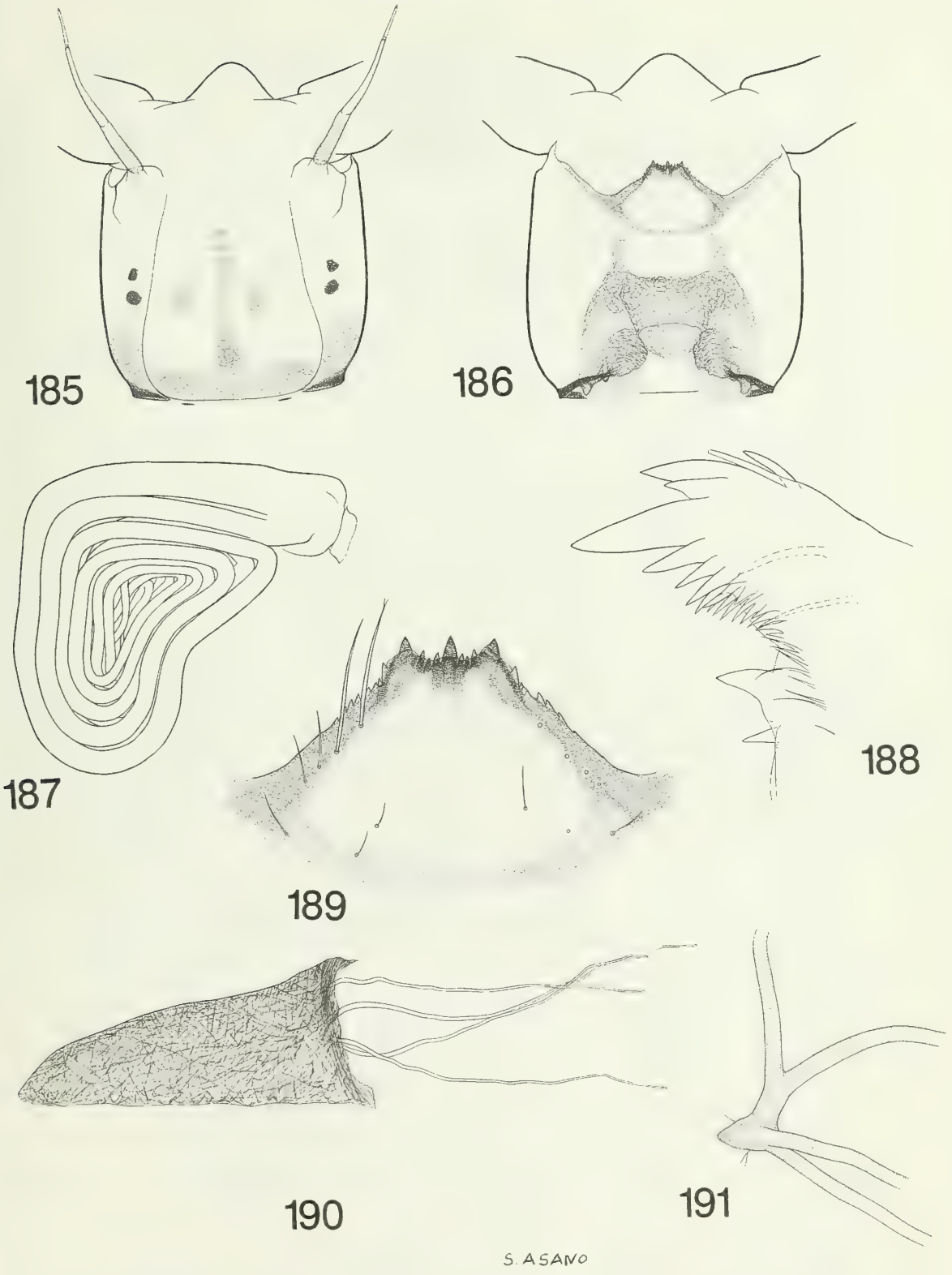




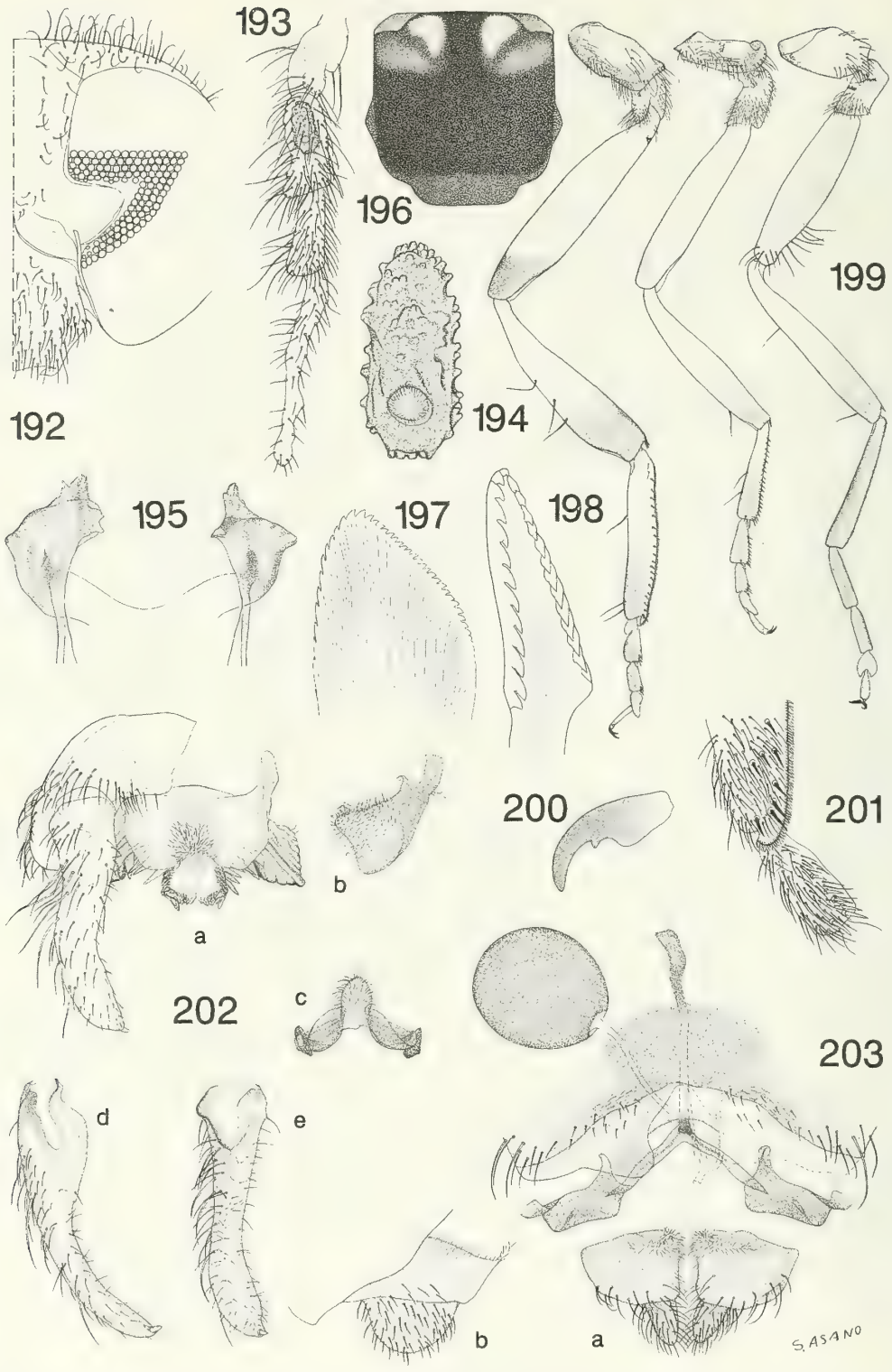
Figs. 171-175. *Simulium* (*Byssodon*) *meridionale*. 171. Head capsule of larva, dorsal view. 172. Hypostoma of larva. 173. Respiratory histoblast of mature larva. 174. Cocoon with pupa. 175. Pupal respiratory organ.



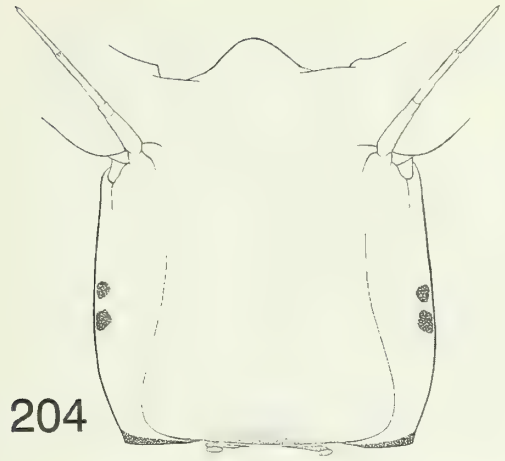
Figs. 176-184. *Simulium* (*Eusimulium*) *aureum*. 176. Head of female. 177. Palpus of female. 178. Sensory vesicle of female, enlarged. 179. Proximal end of female cibarium. 180. Hind, mid-, and forelegs of female. 181. Claw of female. 182. Tip of hind basitarsus and adjoining tarsomere. 183. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 184. Terminalia of female: a) ventral view;) b) lateralview.

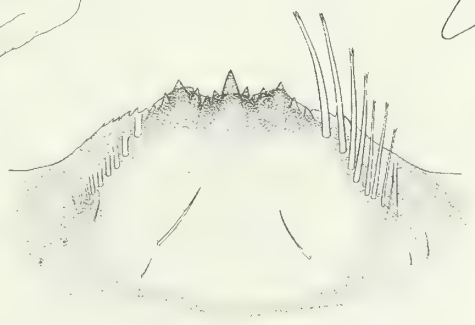


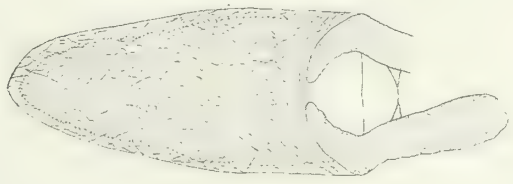
Figs. 185-191. *Simulium* (*Eusimulium*) *aureum*. 185. Head capsule of larva, dorsal view. 186. Head capsule of larva, ventral view. 187. Respiratory histoblast of mature larva. 188. Tip of larval mandible. 189. Hypostoma of larva. 190. Pupal cocoon. 191. Basal portion of pupal respiratory organ.



Figs. 192-203. *Simulium* (*Hearlea*) *canadense*. 192. Head of female. 193. Palpus of female. 194. Sensory vesicle of female, enlarged. 195. Proximal end of female cibarium. 196. Male thorax, dorsal view. 197. Tip of female mandible. 198. Tip of blade of maxilla of female. 199. Hind, mid-, and forelegs of female. 200. Claw of female. 201. Tip of hind basitarsus and adjoining tarsomere. 202. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 203. Terminalia of female: a) ventral view; b) lateral view.







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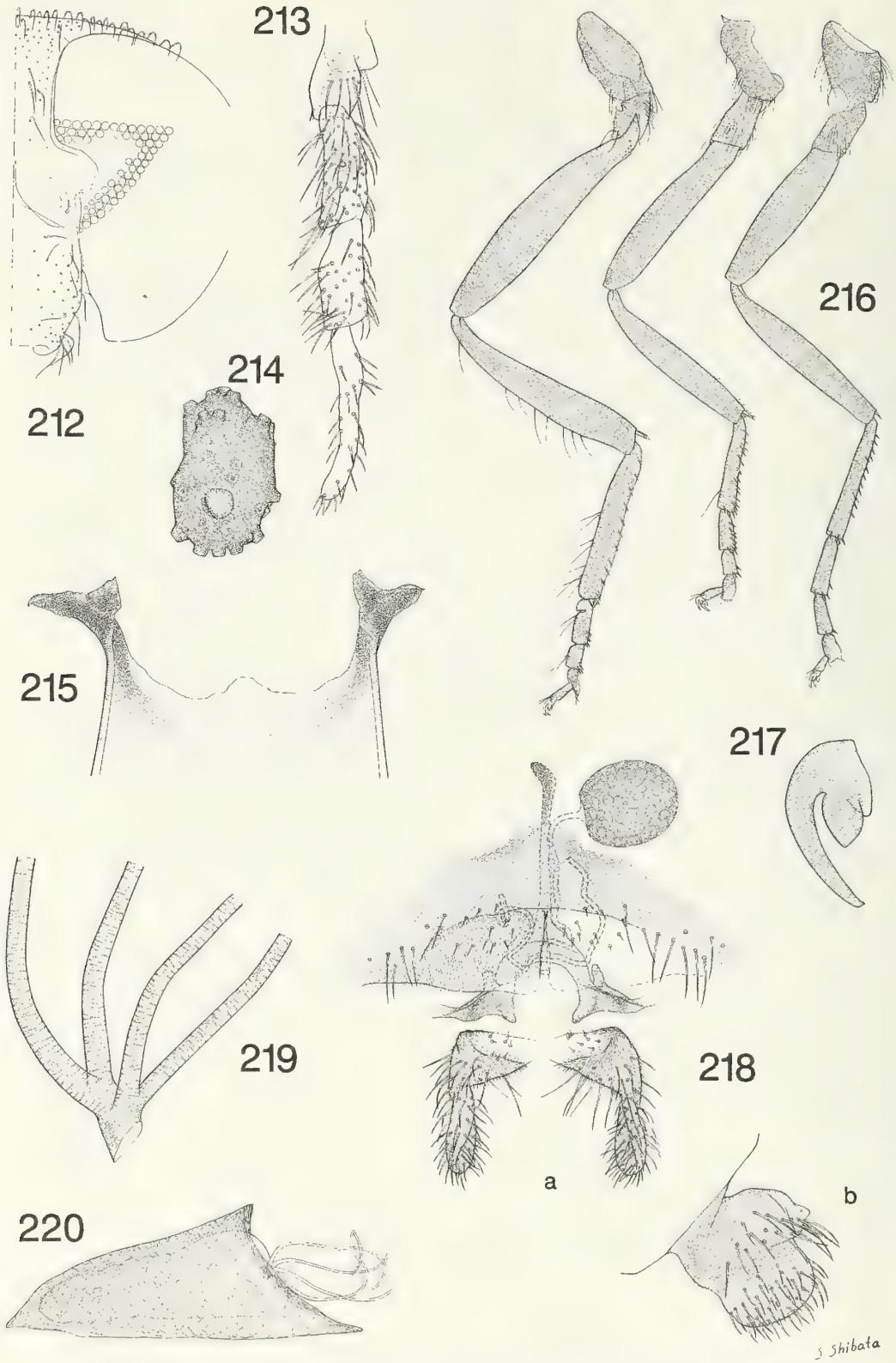
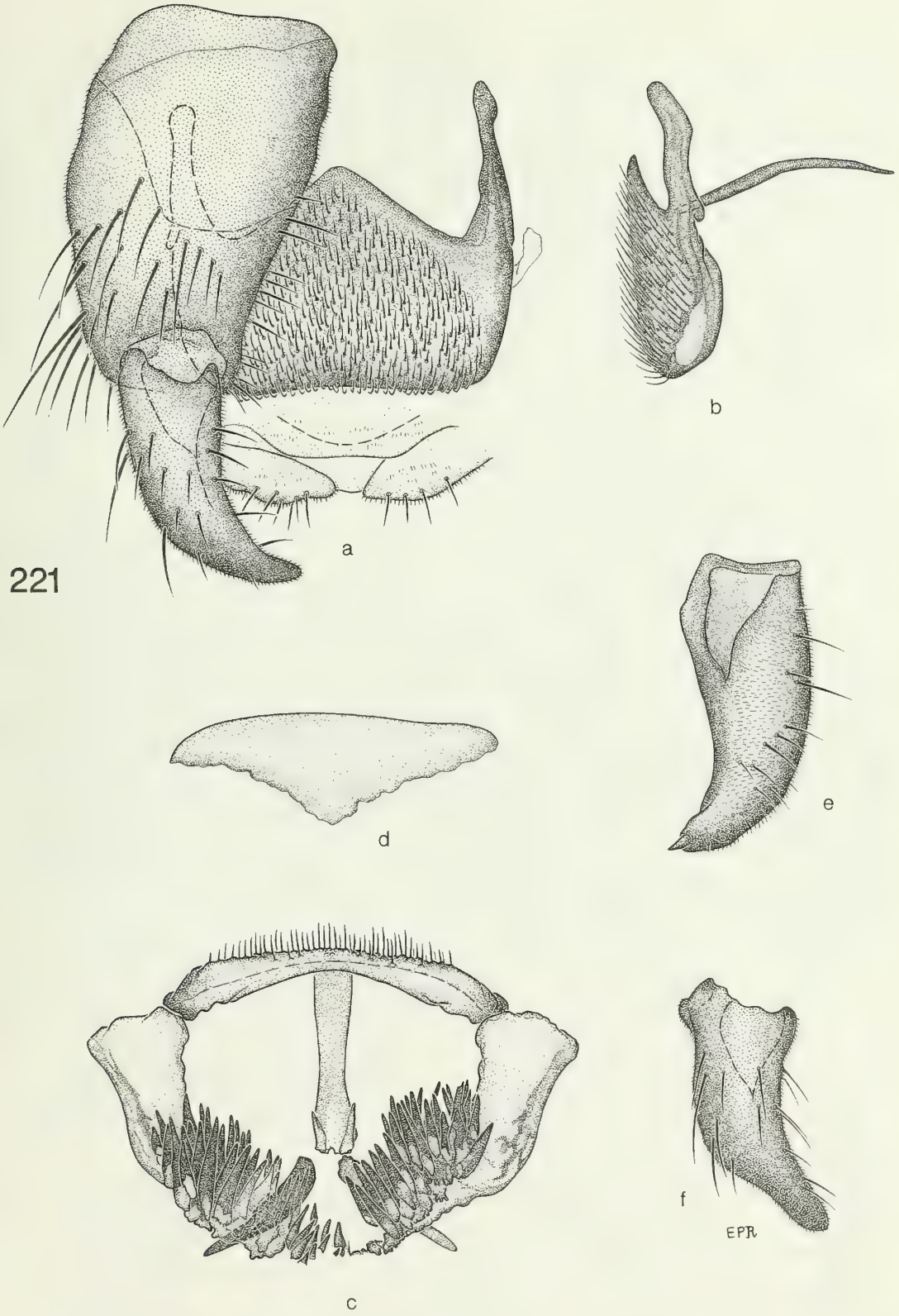
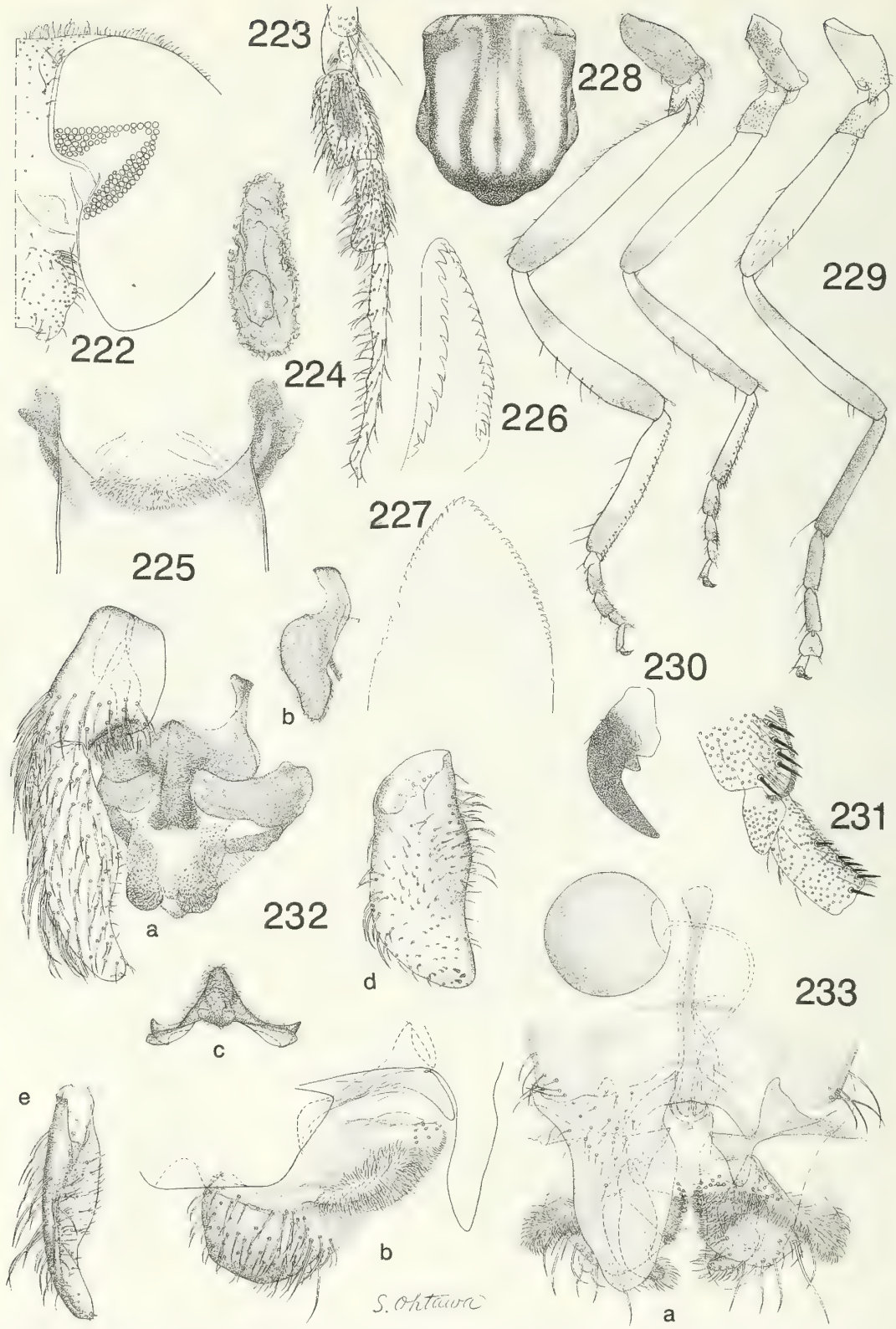
Figs. 204-211. *Simulium* (*Hearlea*) *canadense*. 204. Head capsule of larva, dorsal view. 205. Head capsule of larva, ventral view. 206. Respiratory histoblast of mature larva. 207. Tip of larval mandible. 208. Hypostoma of larva. 209. Anal papillae of larva. 210. Cocoon with pupa, dorsal view. 211. Pupal respiratory organ.



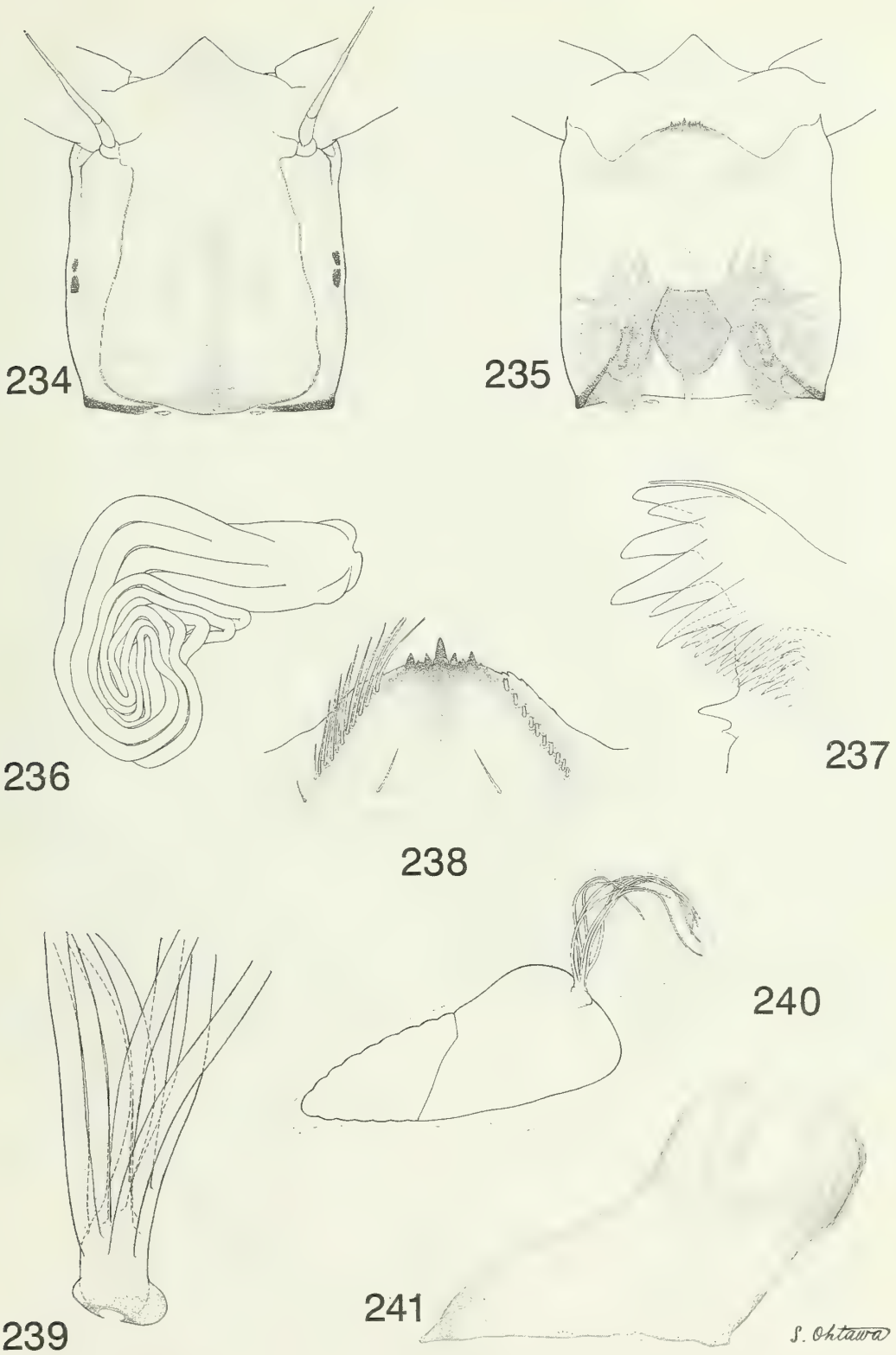
Fig«s. 212-220. *Simulium* (*Hellichiella*) *canonicola*. 212. Head of female. 213. Palpus of female. 214. Sensory vesicle of female, enlarged. 215. Proximal end of female cibarium. 216. Hind, mid-, and forelegs of female. 217. Claw of female. 218. Terminalia of female: a) ventral view; b) lateral view. 219. Basal portion of pupal respiratory organ. 220. Cocoon with pupa.



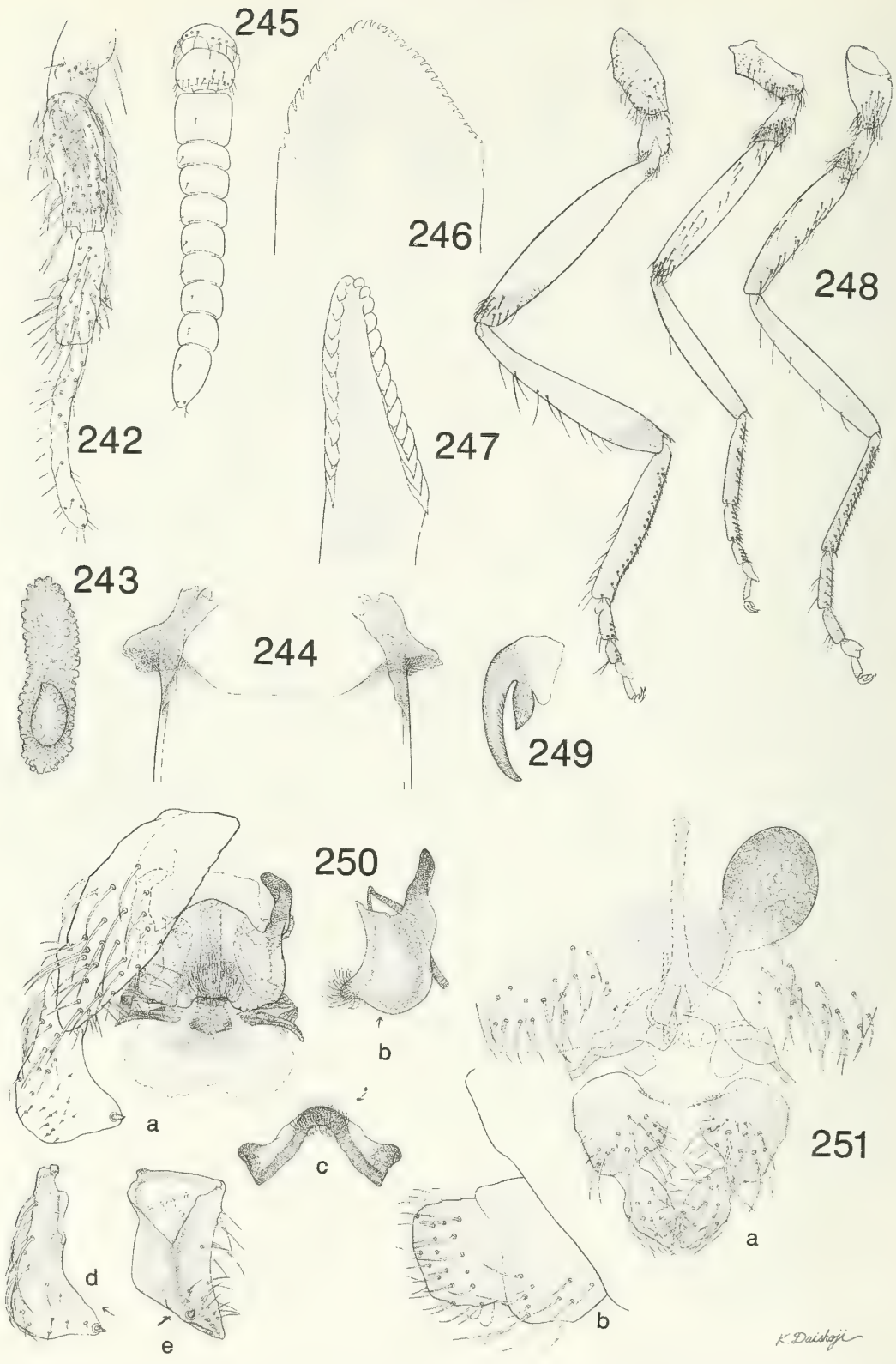
Figs. 221. *Simulium* (*Hellichiella*) *canonicola* male. 221. Terminalia: a) ventral view; b) lateral view; c) terminal (end) view; d) dorsal sclerite; e) inner view of left gonostylus; f) outer view (ventral) of right gonostylus.



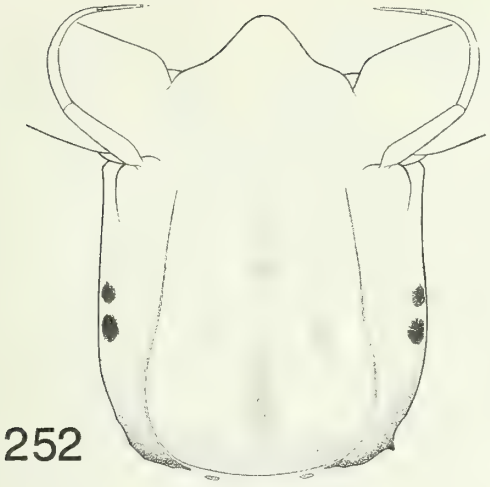
Figs. 222-233. *Simulium* (*Hemicnetha*) *virgatum*. 222. Head of female. 223. Palpus of female. 224. Sensory vesicle of female, enlarged. 225. Proximal end of female cibarium showing armature. 226. Tip of blade of maxilla of female. 227. Tip of female mandible. 228. Female thorax, dorsal view. 229. Hind, mid-, and forelegs of female. 230. Claw of female. 231. Tip of hind basitarsus and adjoining tarsomere. 232. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus; e) lateral view of gonostylus. 233. Terminalia of female: a) ventral view; b) lateral view.

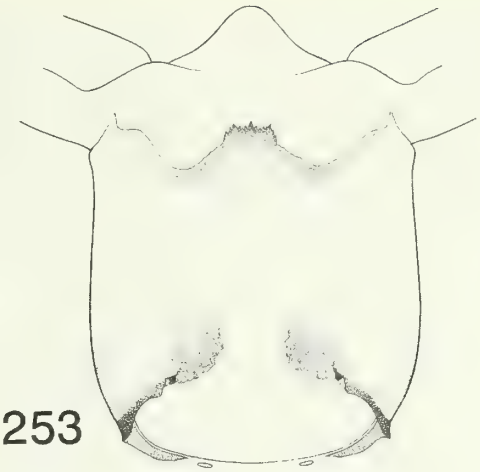


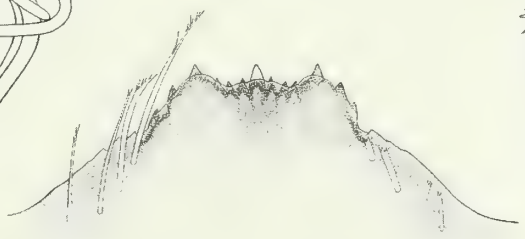
Figs. 234-241. *Simulium* (*Hemicnetha*) *virgatum*. 234. Head capsule of larva, dorsal view. 235. Head capsule of larva, ventral view. 236. Respiratory histoblast of mature larva. 237. Tip of larval mandible. 238. Hypostoma of larva. 239. Basal portion of pupal respiratory organ. 240. Outline of cocoon with pupa. 241. Pupal cocoon.

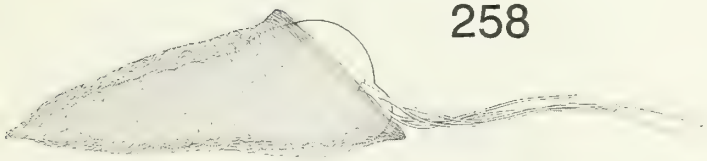


Figs. 242-251. *Simulium* (*Nevermannia*) *pugetense*. 242. Palpus of female. 243. Sensory vesicle of female, enlarged. 244. Proximal end of female cibarium. 245. Antenna of female. 246. Tip of female mandible. 247. Tip of blade of maxilla of female. 248. Hind, mid-, and forelegs of female. 249. Claw of female. 250. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; lateral view of gonostylus; e) inner view of left gonostylus. 251. Terminalia of female: a) ventral view; b) lateral view.

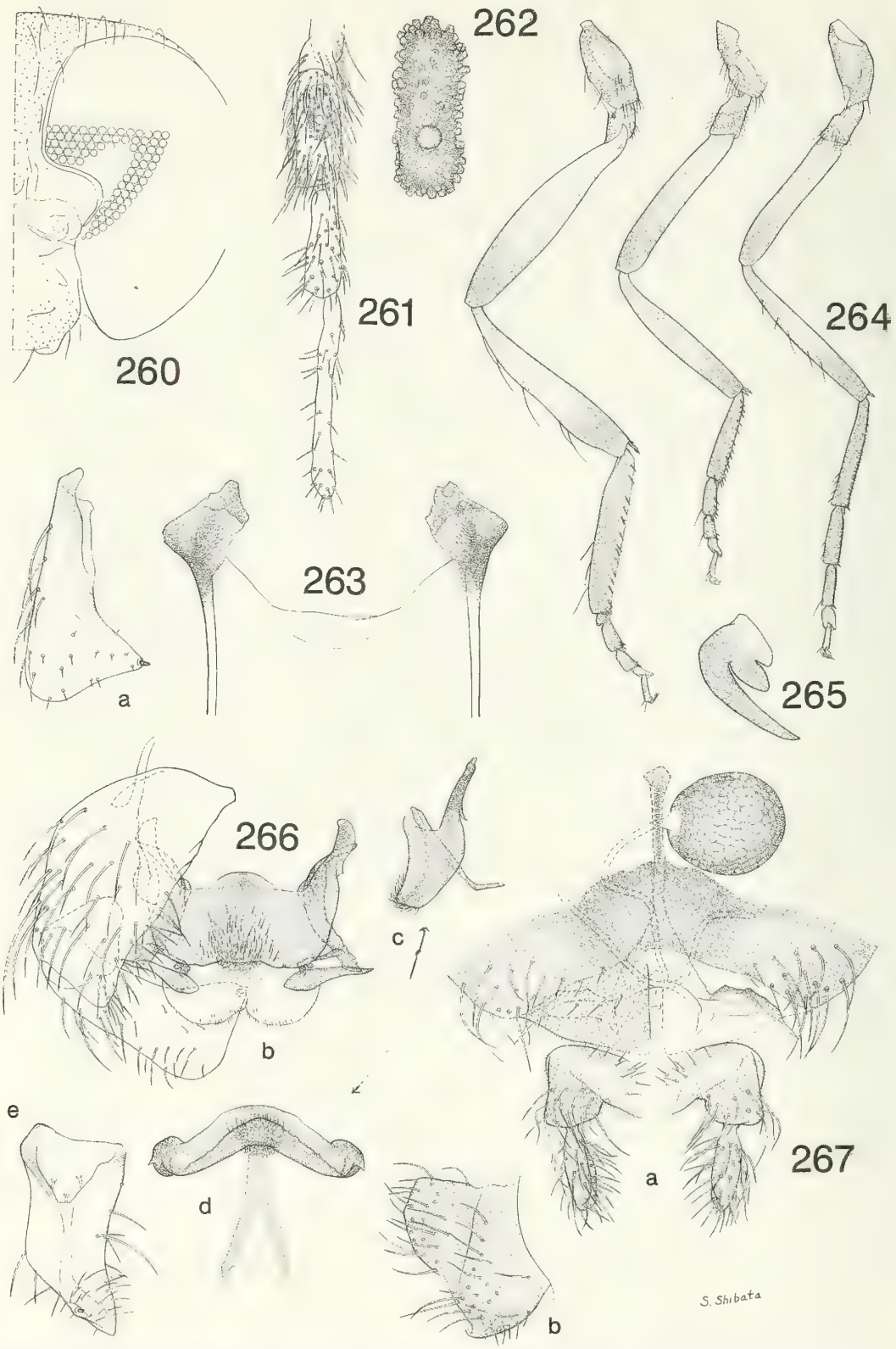




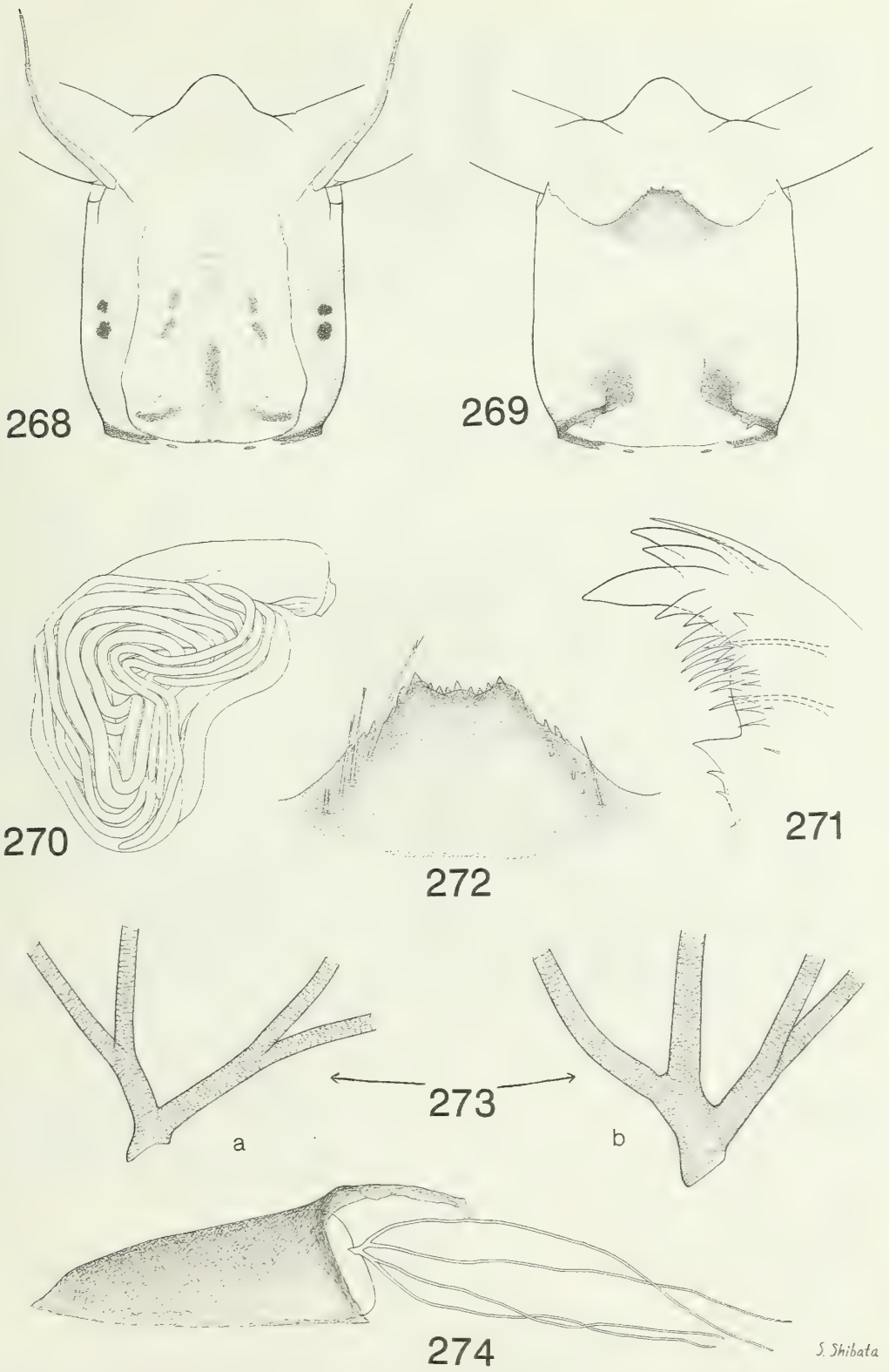




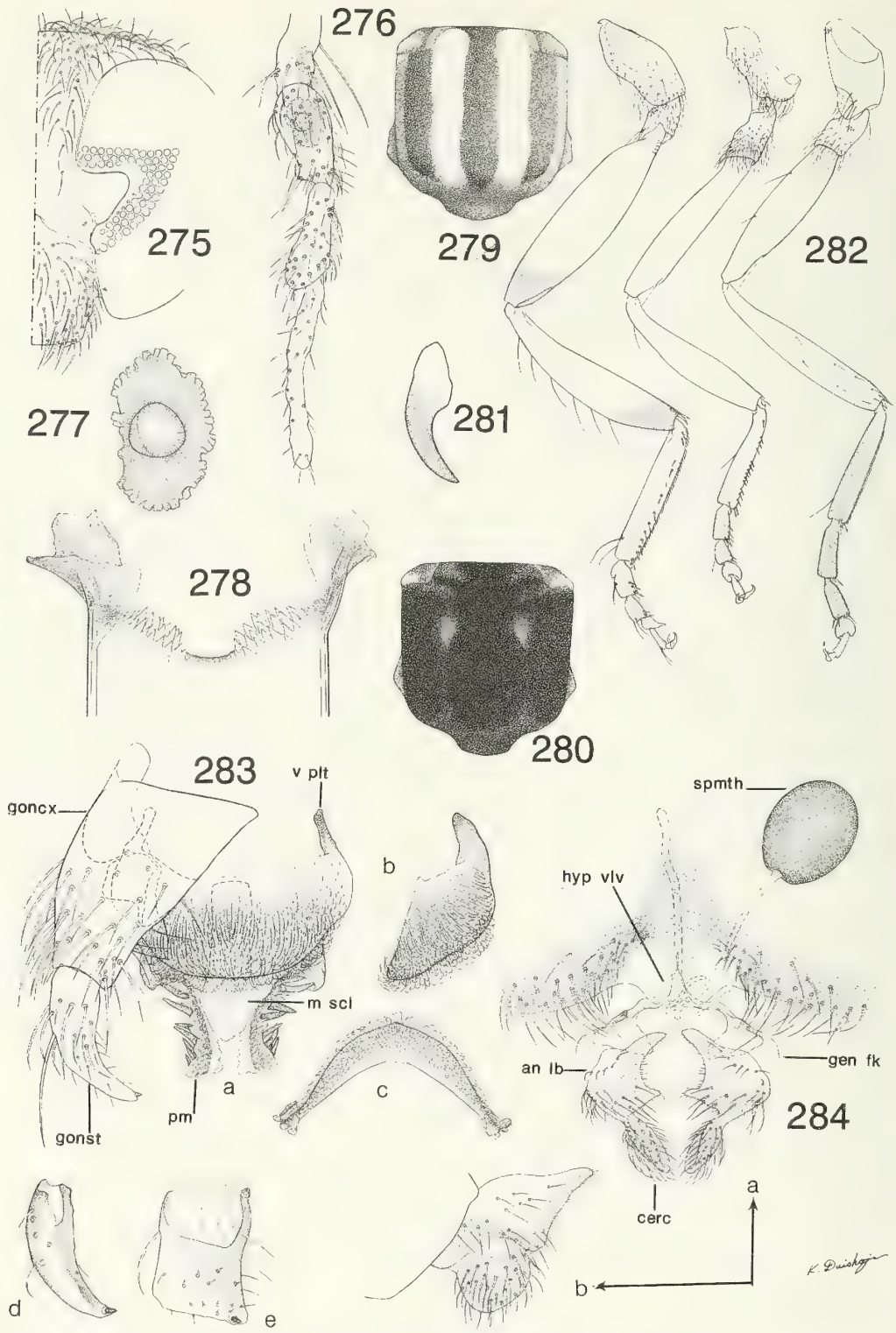
Figs. 252-259. *Simulium* (*Nevermannia*) *pugetense*. 252. Head capsule of larva, dorsal view. 253. Head capsule of larva, ventral view. 254. Respiratory histoblast of mature larva. 255. Tip of larval mandible. 256. Hypostoma of larva. 257. Pupal cocoon, dorsal view. 258. Pupal cocoon with pupa. 259. Basal portion of pupal respiratory organ.



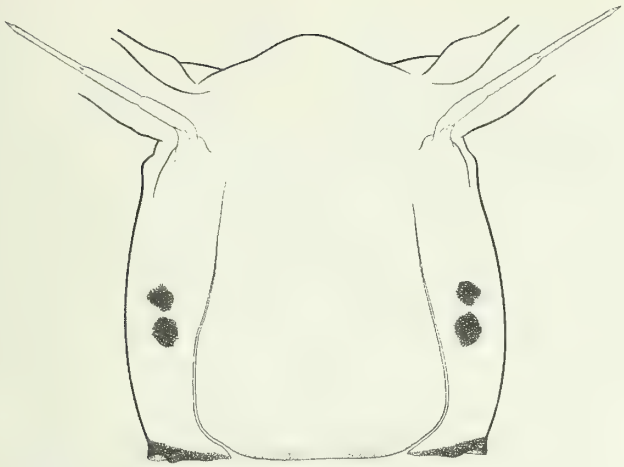
Figs. 260-267. *Simulium* (*Nevermannia*) *vernum*. 260. Head of female. 261. Palpus of female. 262. Sensory vesicle female, enlarged. 263. Proximal end of female cibarium. 264. Hind, mid-, and forelegs of female. 265. Claw of female. 266. Terminalia of male: a) lateral view of gonostylus; b) ventral view; c) lateral view; d) terminal (end) view; e) inner view of left gonostylus. 267. Terminalia of female: a) ventral view; b) lateral view.

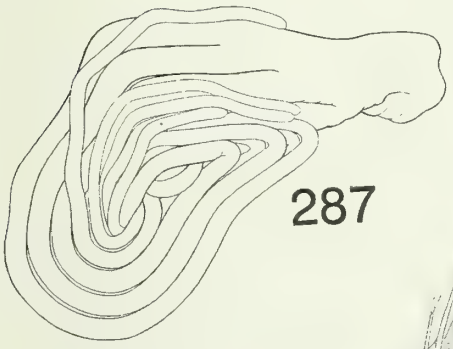


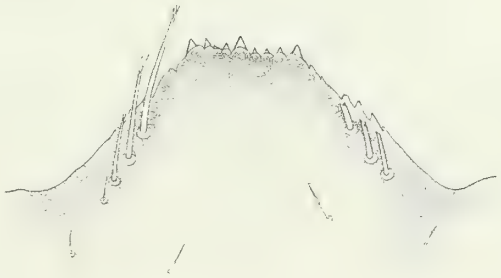
Figs. 268-274. *Simulium* (*Nevermannia*) *vernum*. 268. Head capsule of larva, dorsal view. 269. Head capsule of larva, ventral view. 270. Respiratory histoblast of mature larva. 271. Tip of larval mandible. 272. Hypostoma of larva. 273a, b. Basal portion of pupal respiratory organ showing variation in basal branching pattern. 274. Cocoon with pupa.

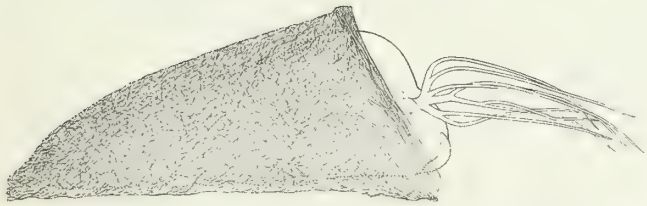


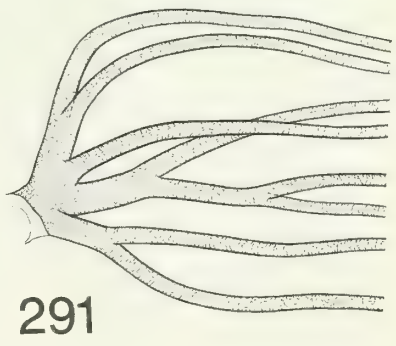
Figs. 275-284. *Simulium* (*Psilopelmia*) *bivittatum*. 275. Head of female. 276. Palpus of female. 277. Sensory vesicle of female, enlarged. 278. Proximal end of female cibarium showing armature. 279. Female thorax, dorsal view. 280. Male thorax, dorsal view. 281. Claw of female. 282. Hind, mid-, and forelegs of female. 283. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 284. Terminalia of female: a) ventral view; b) lateral view. Abbreviations: an lb, anal lobe, cerc, cercus; gen fk, genital fork (sternite 9); goncx, gonocoxite; gonst, gonostylus; hyp vlv, hypogynial valve; m scl, median sclerite of aedeagus; pm, paramere; spmth, spermatheca; v plt, ventral plate of aedeagus.



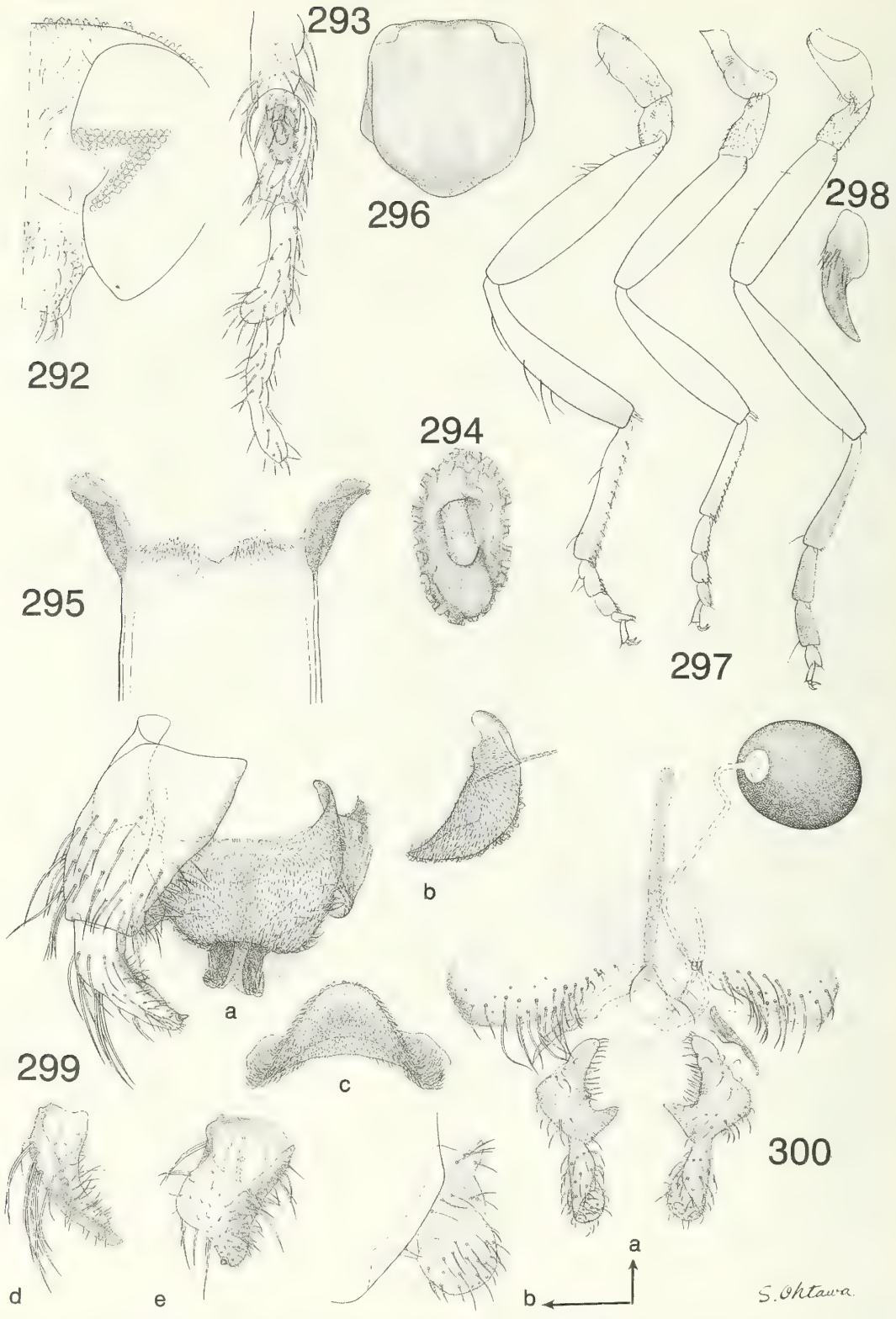




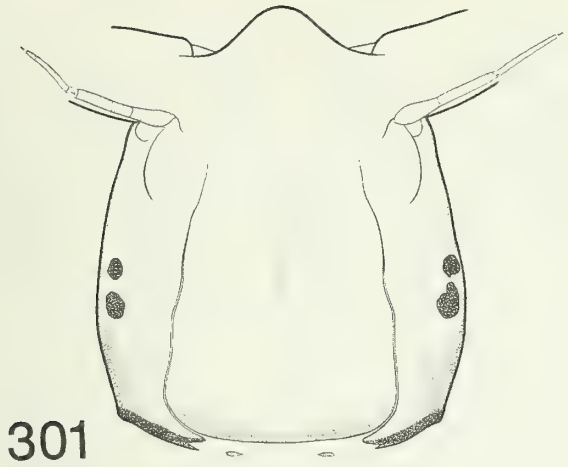


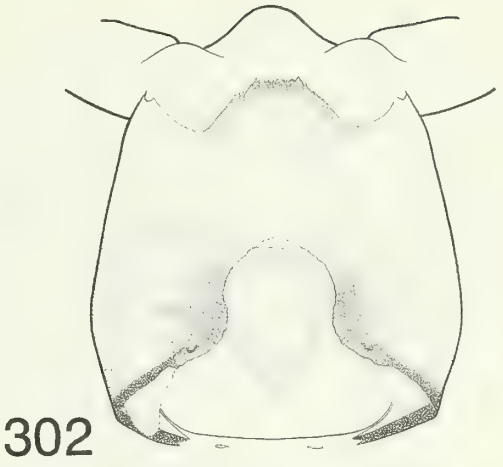


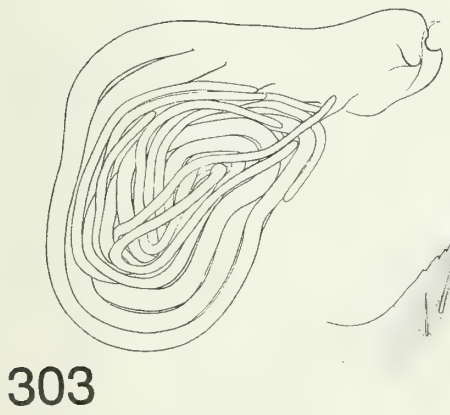
Figs. 285-291. *Simulium* (*Psilopelmia*) *bivittatum*. 285. Head capsule of larva, dorsal view. 286. Head capsule of larva, ventral view. 287. Respiratory histoblast of mature larva. 288. Tip of larval mandible. 289. Hypostoma of larva. 290. Cocoon with pupa 291. Basal portion of pupal respiratory organ.

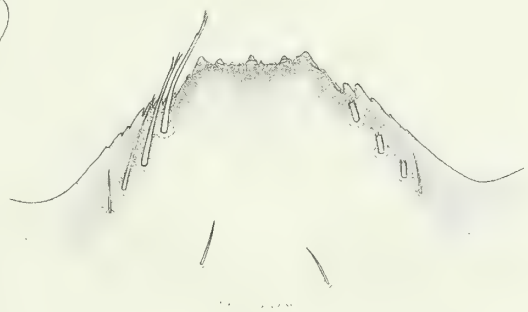


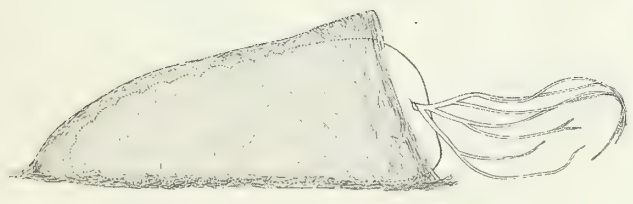
Figs. 292-300. *Simulium* (*Psilopelmia*) *griseum*. 292. Head of female. 293. Palpus of female. 294. Sensory vesicle of female, enlarged. 295. Proximal end of female cibarium showing armature. 296. Female thorax, dorsal view. 297. Hind, mid-, and forelegs of female. 298. Claw of female. 299. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 300. Terminalia of female: a) ventral view; b) lateral view.

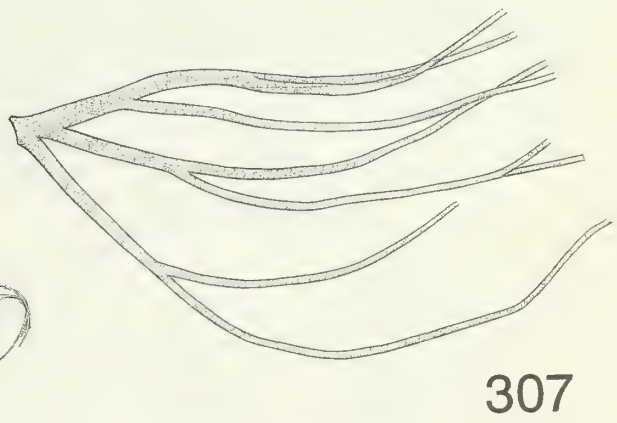












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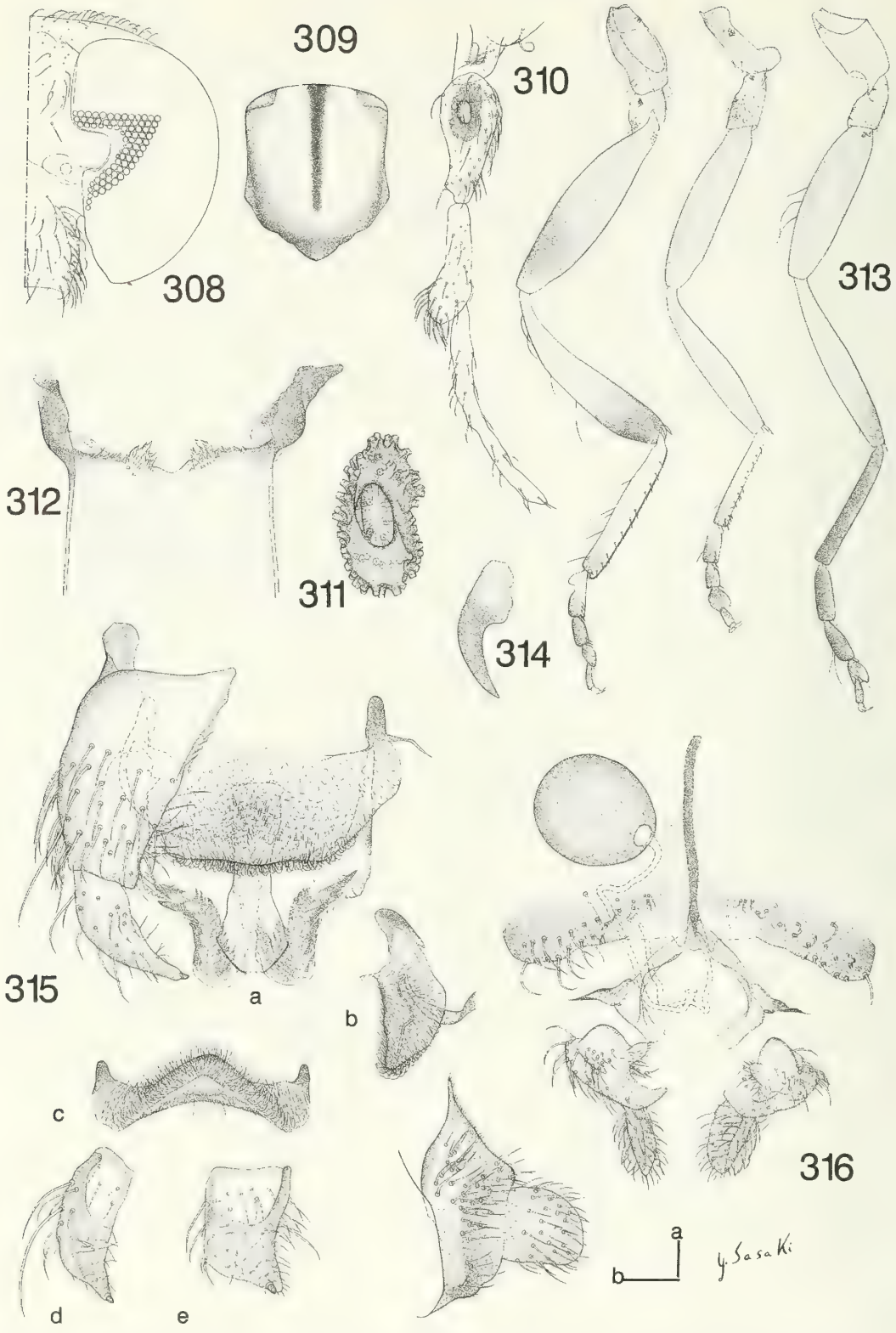
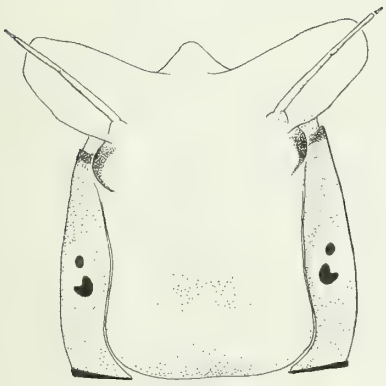
Figs. 301-307. *Simulium* (*Psilopelmia*) *griseum*. 301. Head capsule of larva, dorsal view. 302. Head capsule of larva, ventral view. 303. Respiratory histoblast of mature larva. 304. Tip of larval mandible. 305. Hypostoma of larva. 306. Cocoon with pupa. 307. Pupal respiratory organ.



Figs. 308-316. *Simulium* (*Psilopelmia*) *venator*. 308. Head of female. 309. Female thorax, dorsal view. 310. Palpus of female. 311. Sensory vesicle of female, enlarged. 312. Proximal end of female cibarium showing armature. 313. Hind, mid-, and forelegs of female. 314. Claw of female. 315. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 316. Terminalia of female: a) ventral view; b) lateral view.



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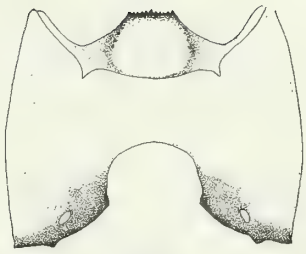

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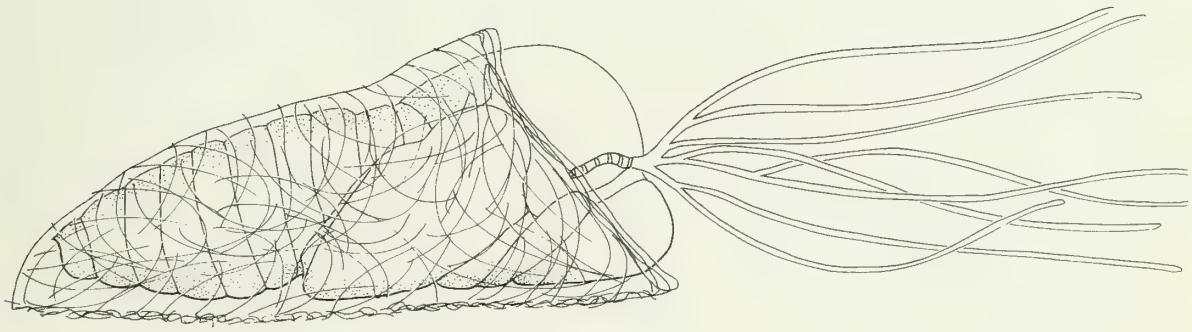

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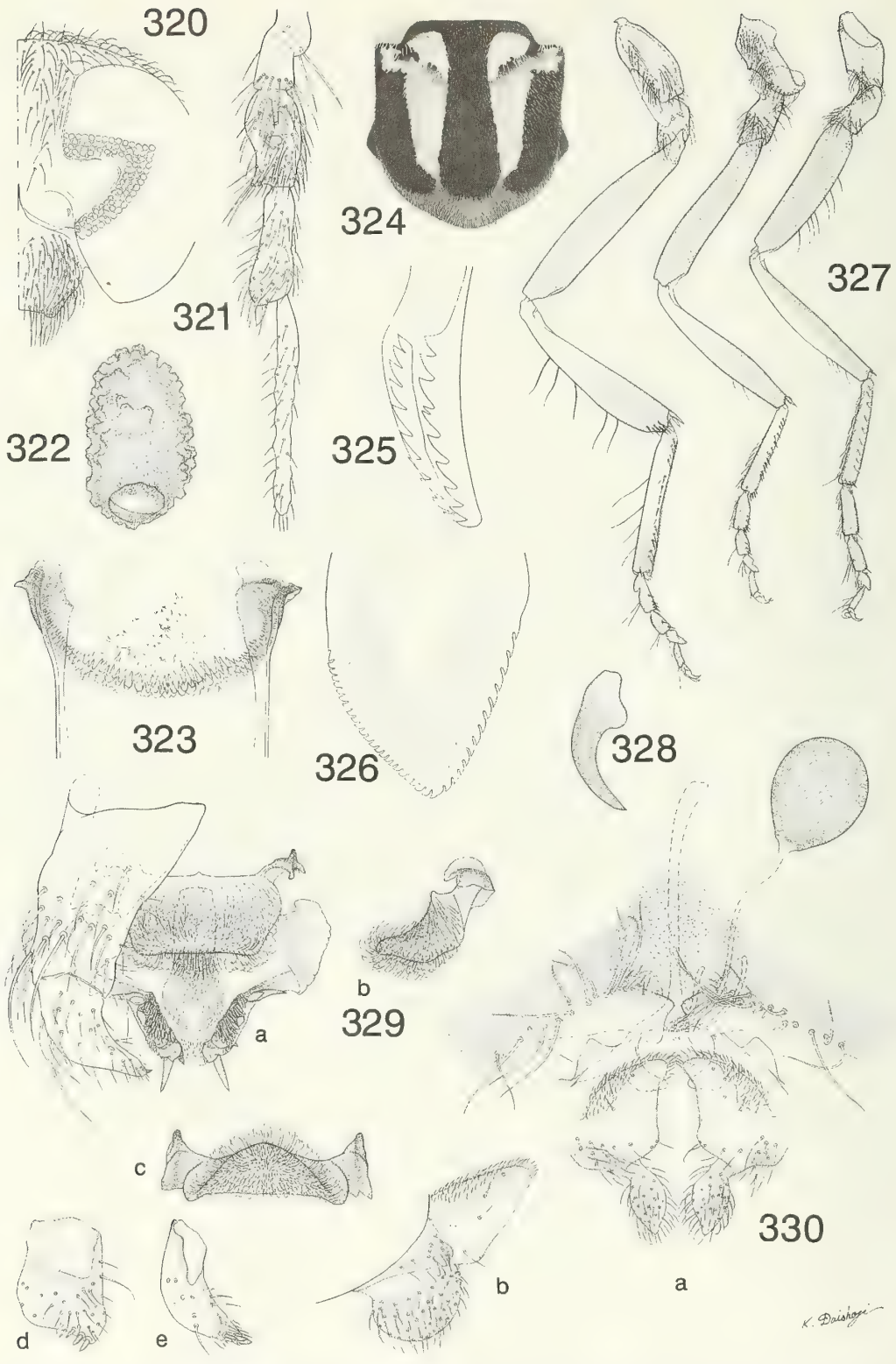
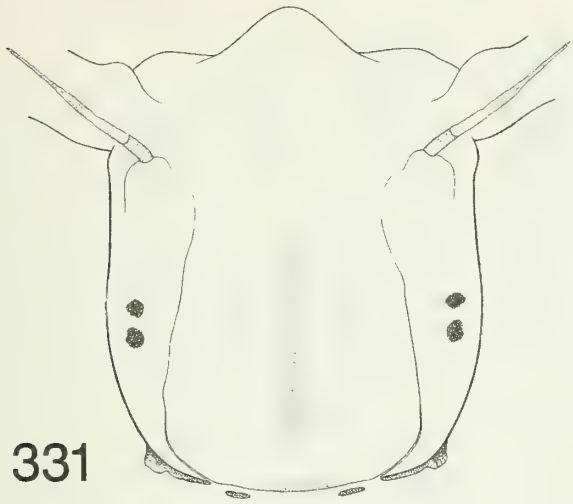
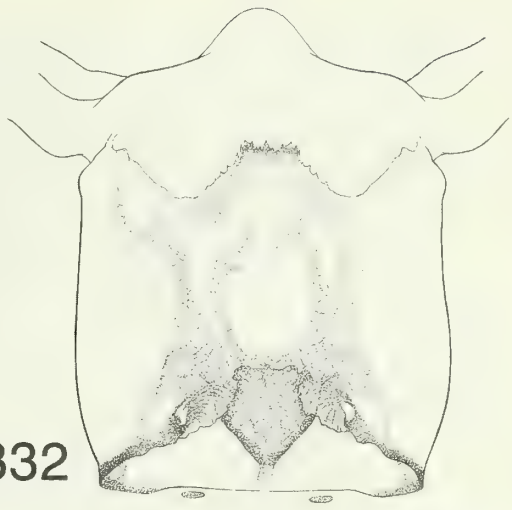
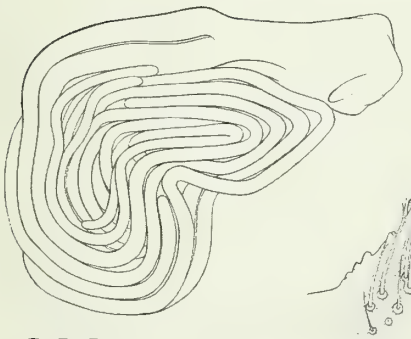
Figs. 317-319. *Simulium* (*Psilopelmia*) *venator*. 317. Larval head capsule, dorsal view. 318. Larval head capsule, ventral view. 319. pupal cocoon with pupa.

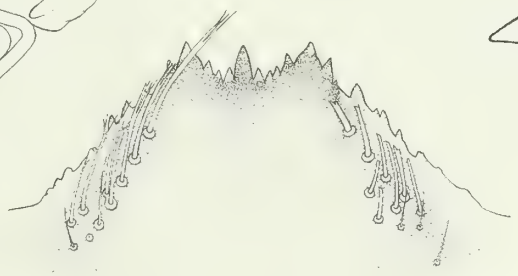


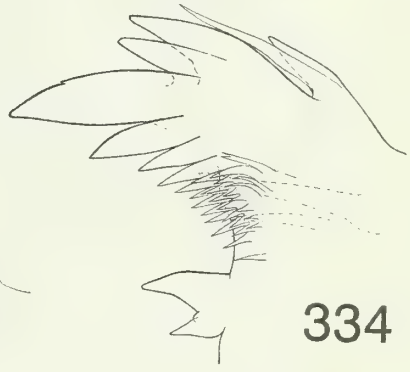
Figs. 320-330. *Simulium* (*Psilozia*) *argus*. 320. Head of female. 321. Palpus of female. 322. Sensory vesicle of female, enlarged. 323. Proximal end of female cibarium showing armature. 324. Male thorax, dorsal view. 325. Tip of blade of maxilla of female. 326. Tip of female mandible. 327. Hind, mid-, and forelegs of female. 328. Claw of female. 329. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus; e) lateral view of gonostylus. 330. Terminalia of female: a) ventral view; b) lateral view.

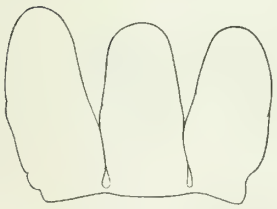


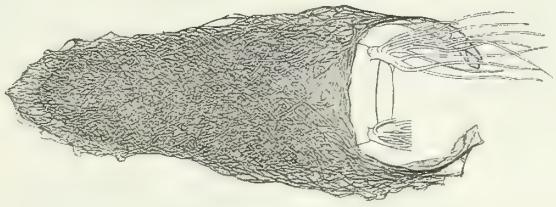


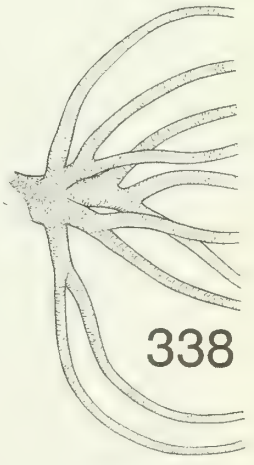




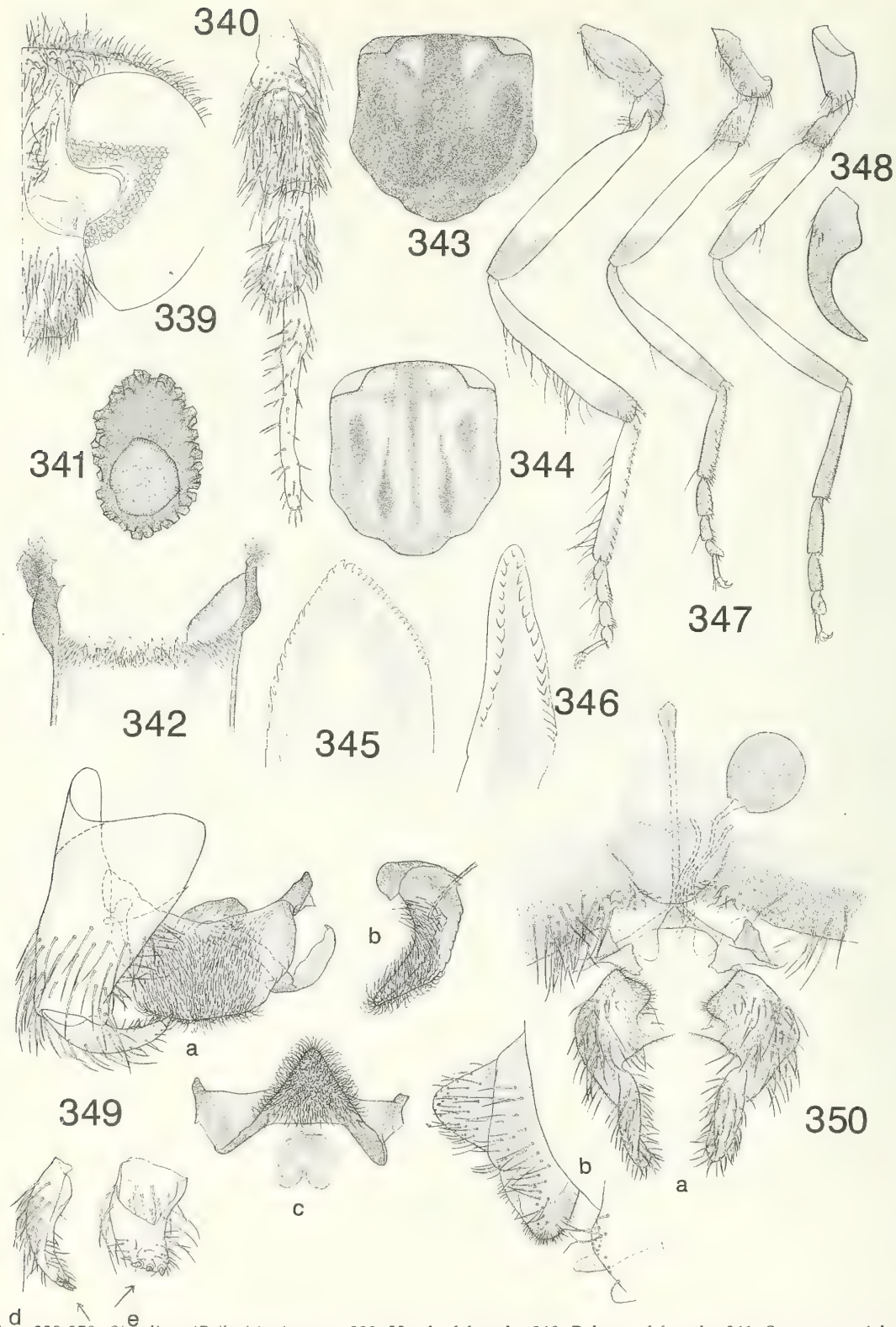




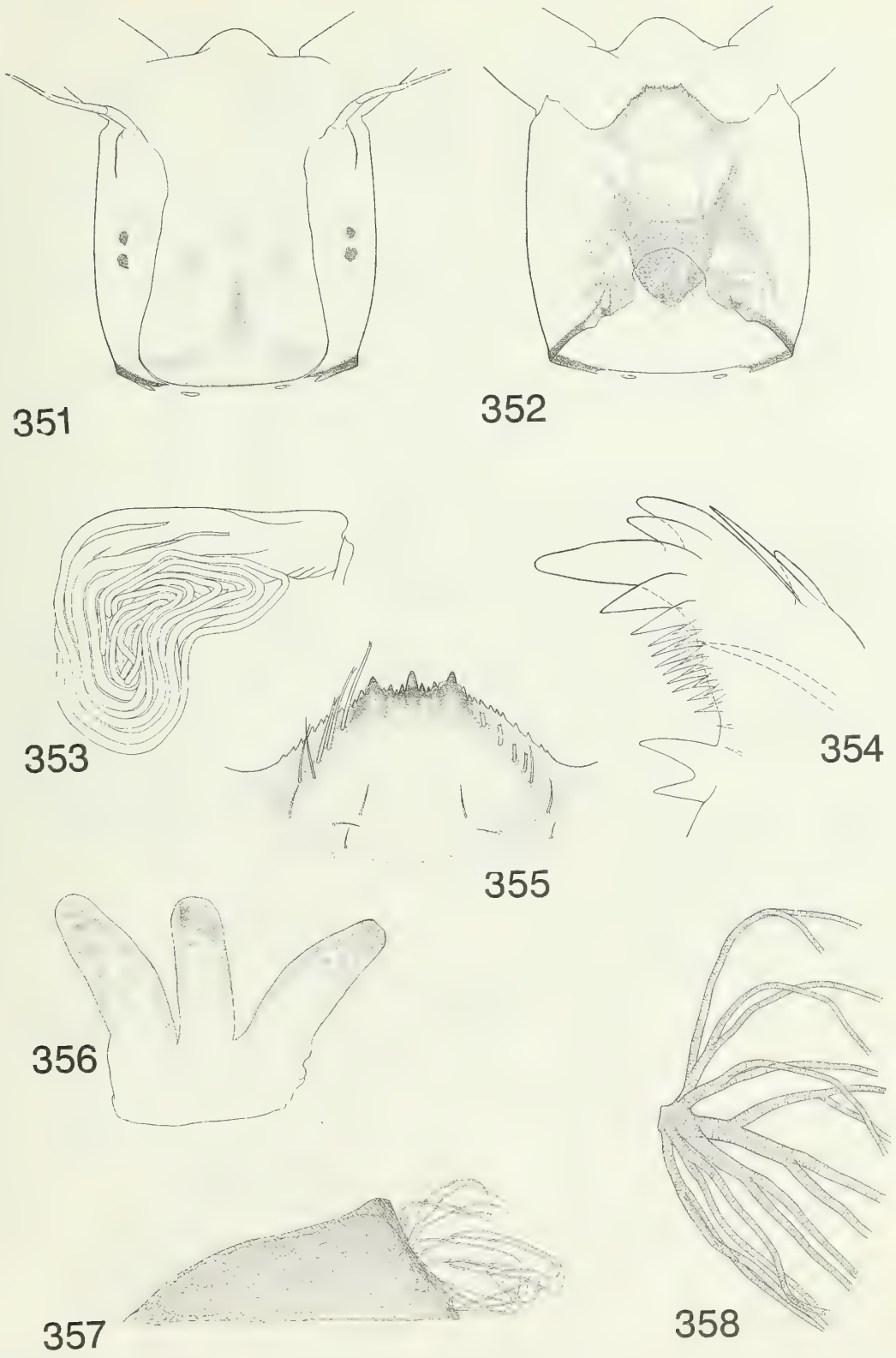




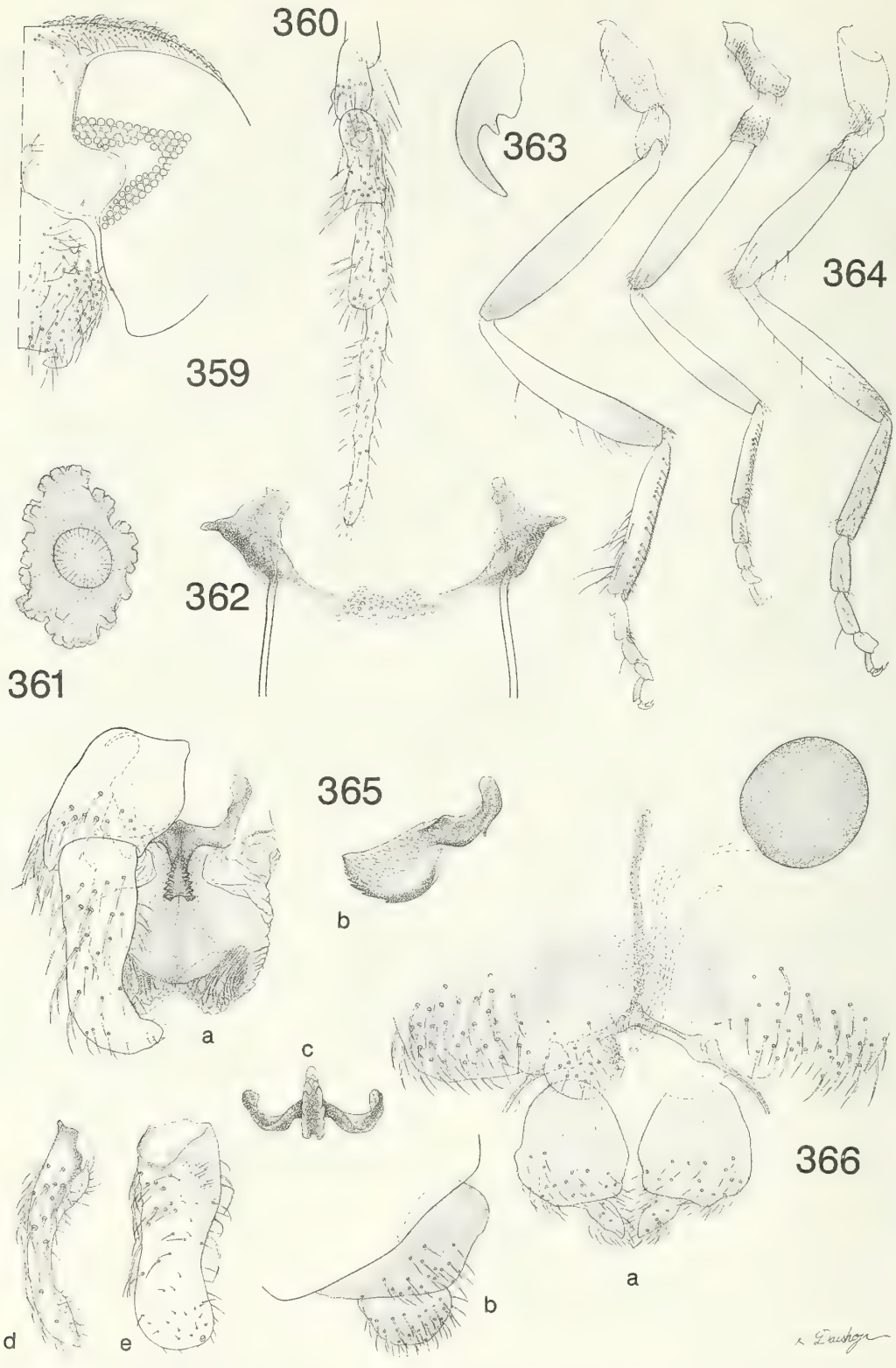
Figs. 331-338. *Simulium* (*Psilozia*) *argus*. 331. Head capsule of larva, dorsal view. 332. Head capsule of larva, ventral view. 333. Respiratory histoblast of mature larva. 334. Tip of larval mandible. 335. Hypostoma of larva. 336. Anal papillae of larva. 337. Cocoon with pupa. 338. Basal portion of pupal respiratory organ.



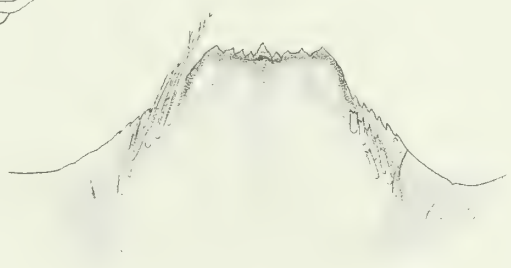
Figs. 339-350. *Simulium* (*Psilozia*) *vittatum*. 339. Head of female. 340. Palpus of female. 341. Sensory vesicle of female, enlarged. 342. Proximal end of female cibarium showing armature. 343. Male thorax, dorsal view. 344. Female thorax, dorsal view. 345. Tip of female mandible. 346. Tip of blade of maxilla of female. 347. Hind, mid-, and forelegs of female. 348. Claw of female. 349. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 350. Terminalia of female: a) ventral view; b) lateral view.

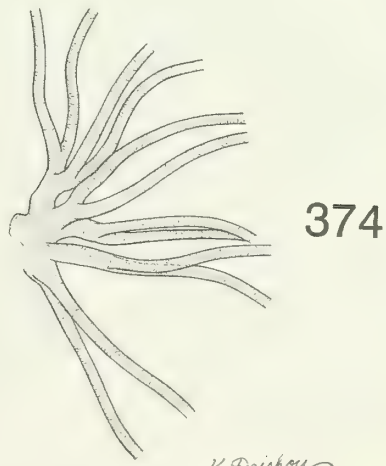


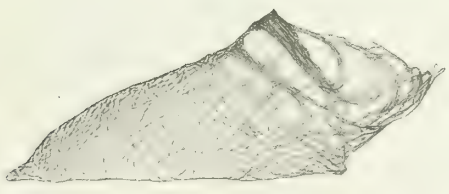
Figs. 351-358. *Simulium* (*Psilozia*) *vittatum*. 351. Head capsule of larva, dorsal view. 352. Head capsule of larva, ventral view 353. Respiratory histoblast of mature larva. 354. Tip of larval mandible. 355. Hypostoma of larva. 356. Anal papillae of larva 357. Cocoon with pupa. 358. Basal portion of pupal respiratory organ.



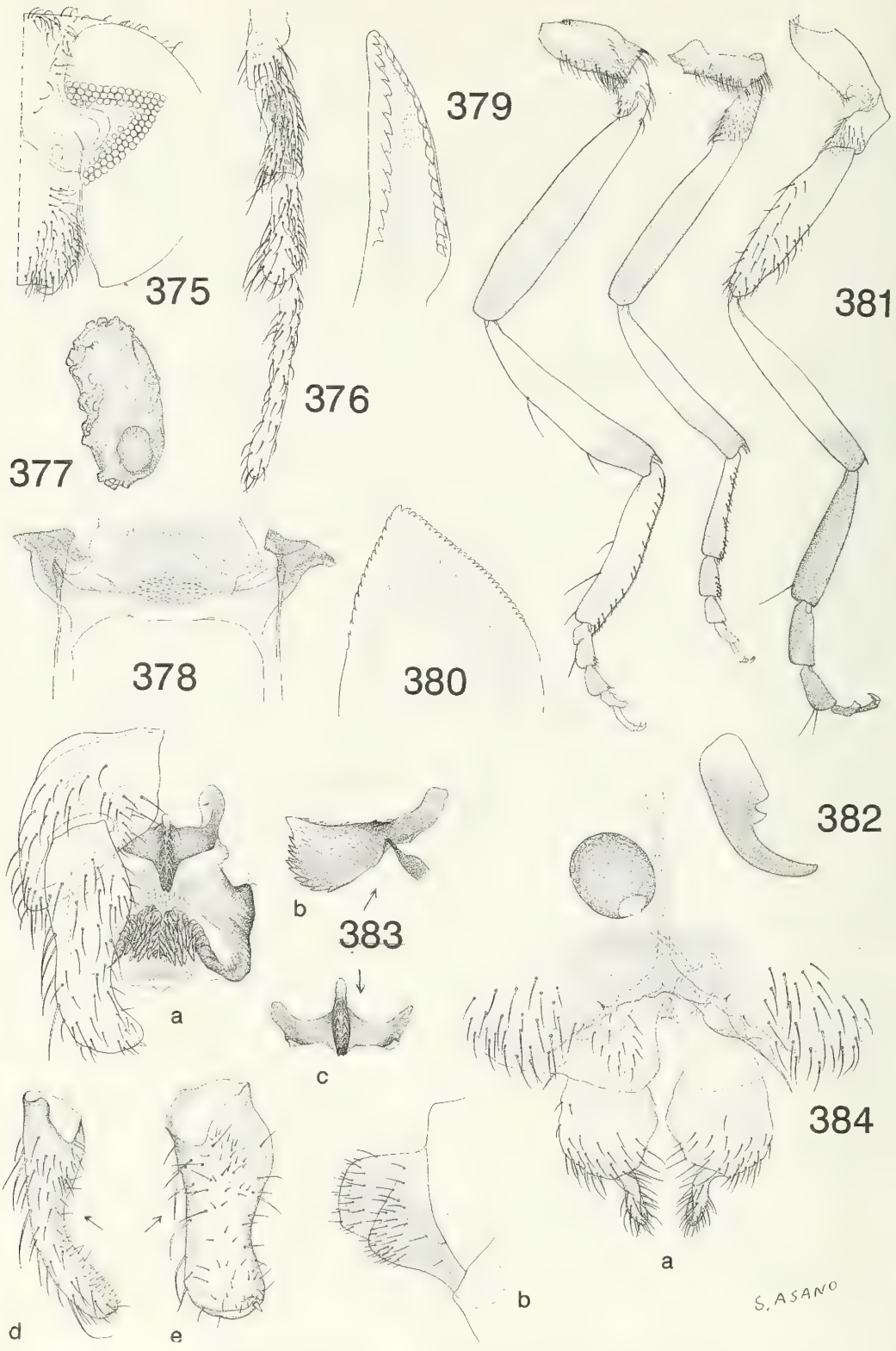
Figs. 359-366. *Simulium* (*Simulium*) *arcticum*. 359. Head of female. 360. Palpus of female. 361. Sensory vesicle of female, enlarged. 362. Proximal end of female cibarium showing armature. 363. Claw of female. 364. Hind, mid-, and forelegs of female. 365. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 366. Terminalia of female: a) ventral view; b) lateral view.



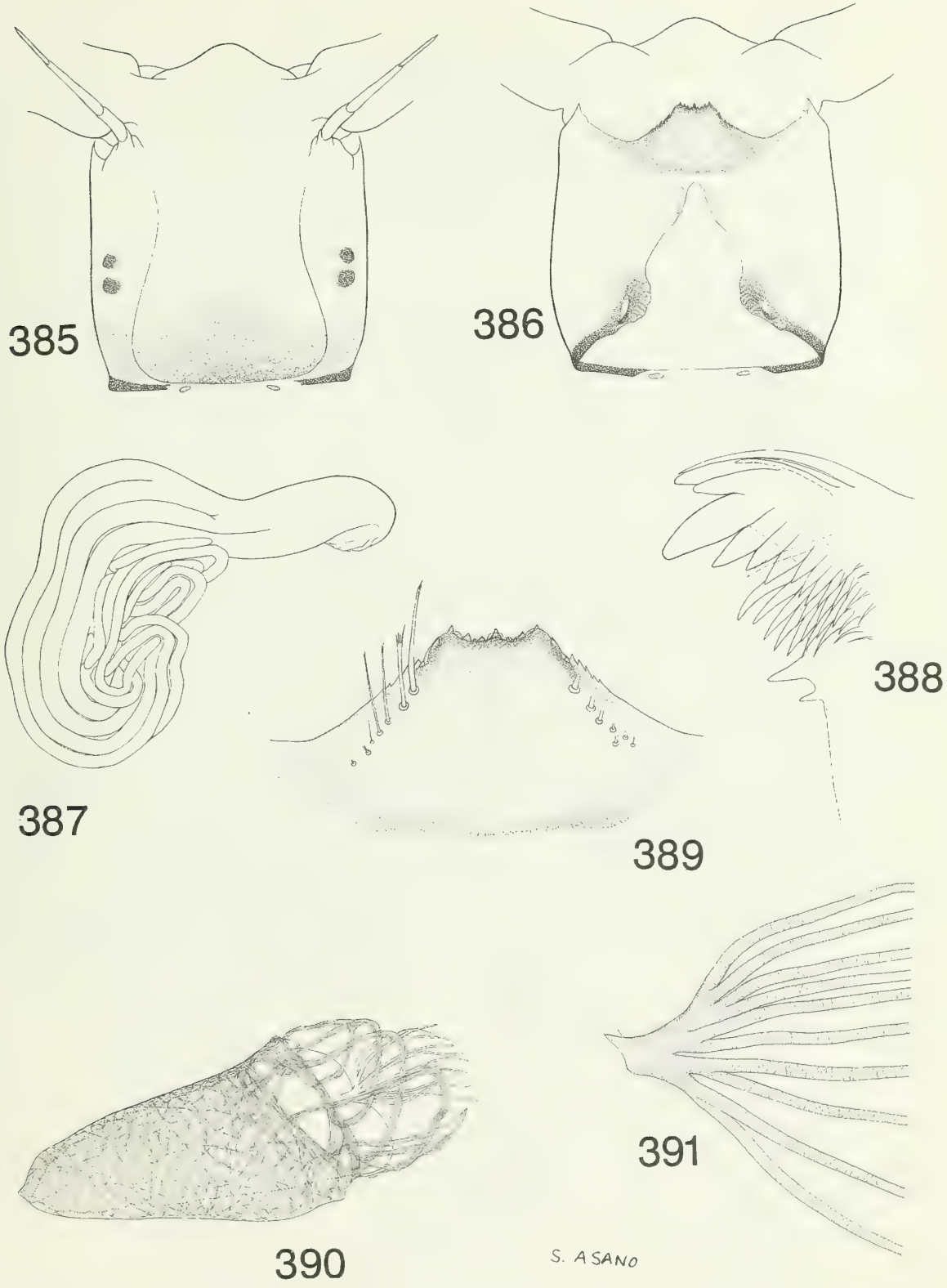




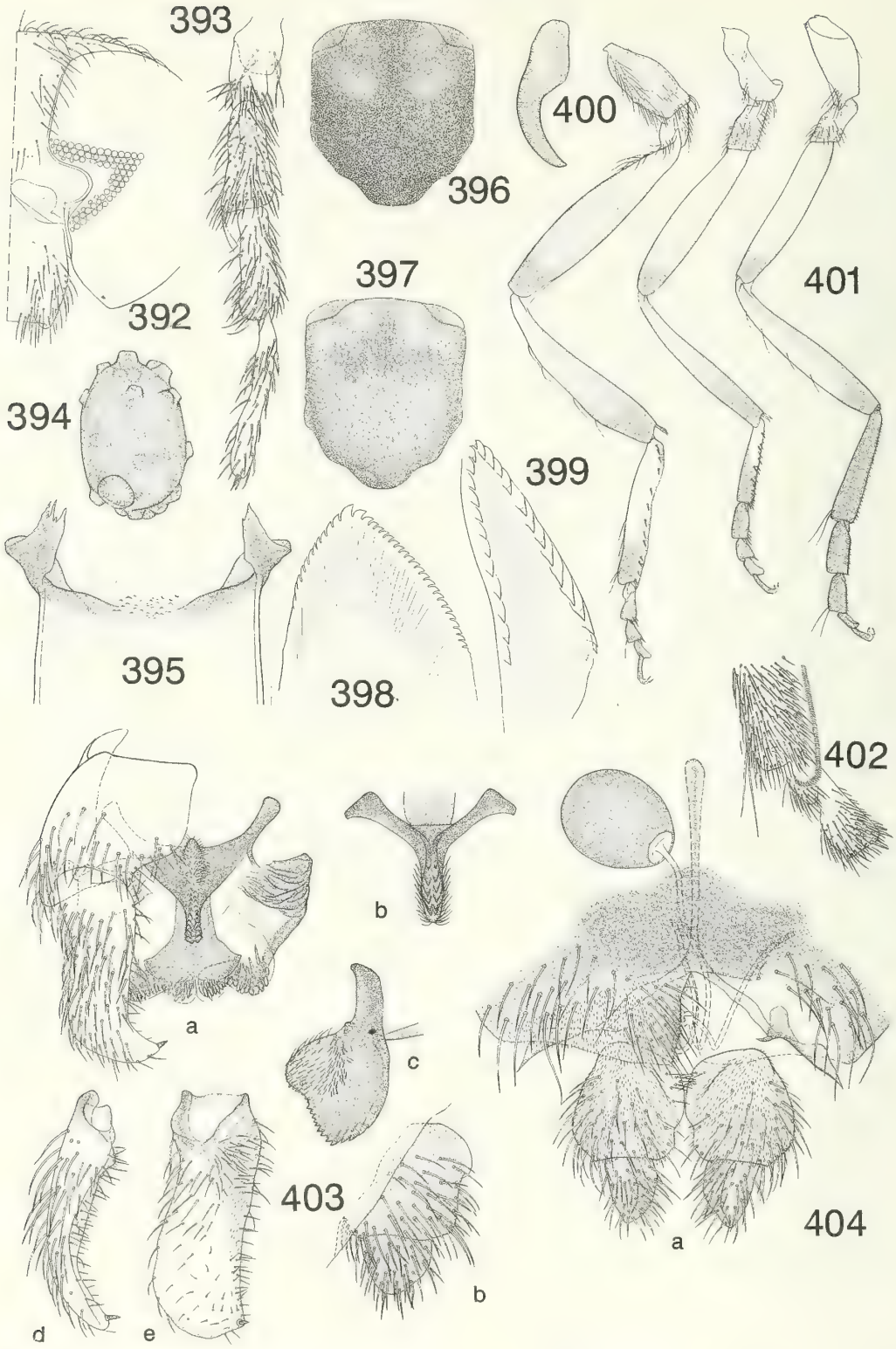
Figs. 367-374. *Simulium* (*Simulium*) *arcticum*. 367. Head capsule of larva, dorsal view. 368. Head capsule of larva, ventral view. 369. Respiratory histoblast of mature larva. 370. Tip of larval mandible. 371. Hypostoma of larva. 372. Outline of cocoon with pupa. 373. Pupal cocoon. 374. Basal portion of pupal respiratory organ.



Figs. 375-384. *Simulium* (*Simulium*) *corbis*. 375. Head of female. 376. Palpus of female. 377. Sensory vesicle of female, enlarged. 378. Proximal end of female cibarium showing armature. 379. Tip of blade of maxilla of female. 380. Tip of female mandible. 381. Hind, mid-, and forelegs of female. 382. Claw of female. 383. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d). lateral view of gonostylus; e) inner view of left gonostylus. 384. Terminalia of female: a) ventral view; b) lateral view.



Figs. 385-391. *Simulium* (*Simulium*) *corbis*. 385. Head capsule of larva, dorsal view. 386. Head capsule of larva, ventral view. 387. Respiratory histoblast of mature larva. 388. Tip of larval mandible. 389. Hypostoma of larva. 390. Cocoon with pupa. 391. Basal portion of pupal respiratory organ.



Figs. 392-404. *Simulium* (*Simulium*) *decorum*. 392. Head of female. 393. Palpus of female. 394. Sensory vesicle of female, enlarged. 395. Proximal end of female cibarium showing armature. 396. Male thorax, dorsal view. 397. Female thorax, dorsal view. 398. Tip of female mandible. 399. Tip of blade of maxilla of female. 400. Claw of female. 401. Hind, mid-, and forelegs of female. 402. Tip of hind basitarsus and adjoining tarsomere. 403. Terminalia of male: a) ventral view; b) terminal (end) view; c) lateral view; d) lateral view of gonostylus; e) inner view of left gonostylus. 404. Terminalia of female: a) ventral view; b) lateral view.

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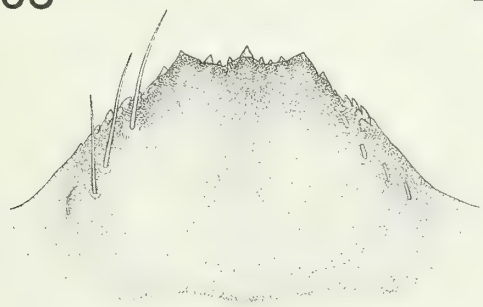

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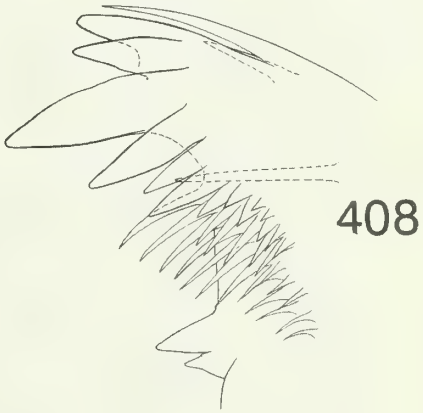

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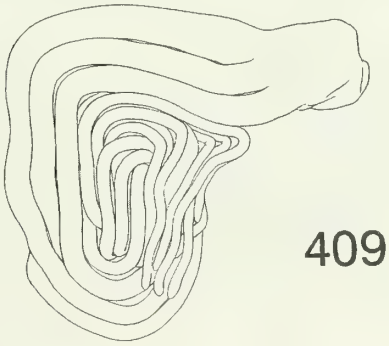

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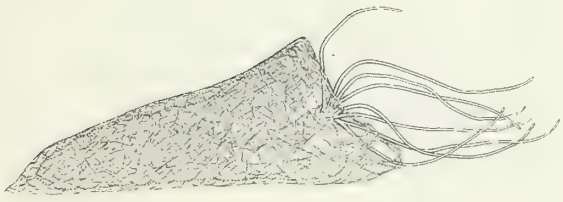

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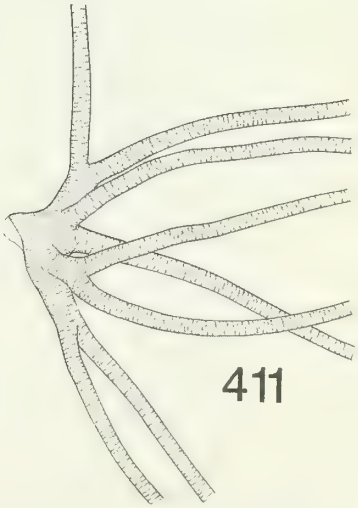
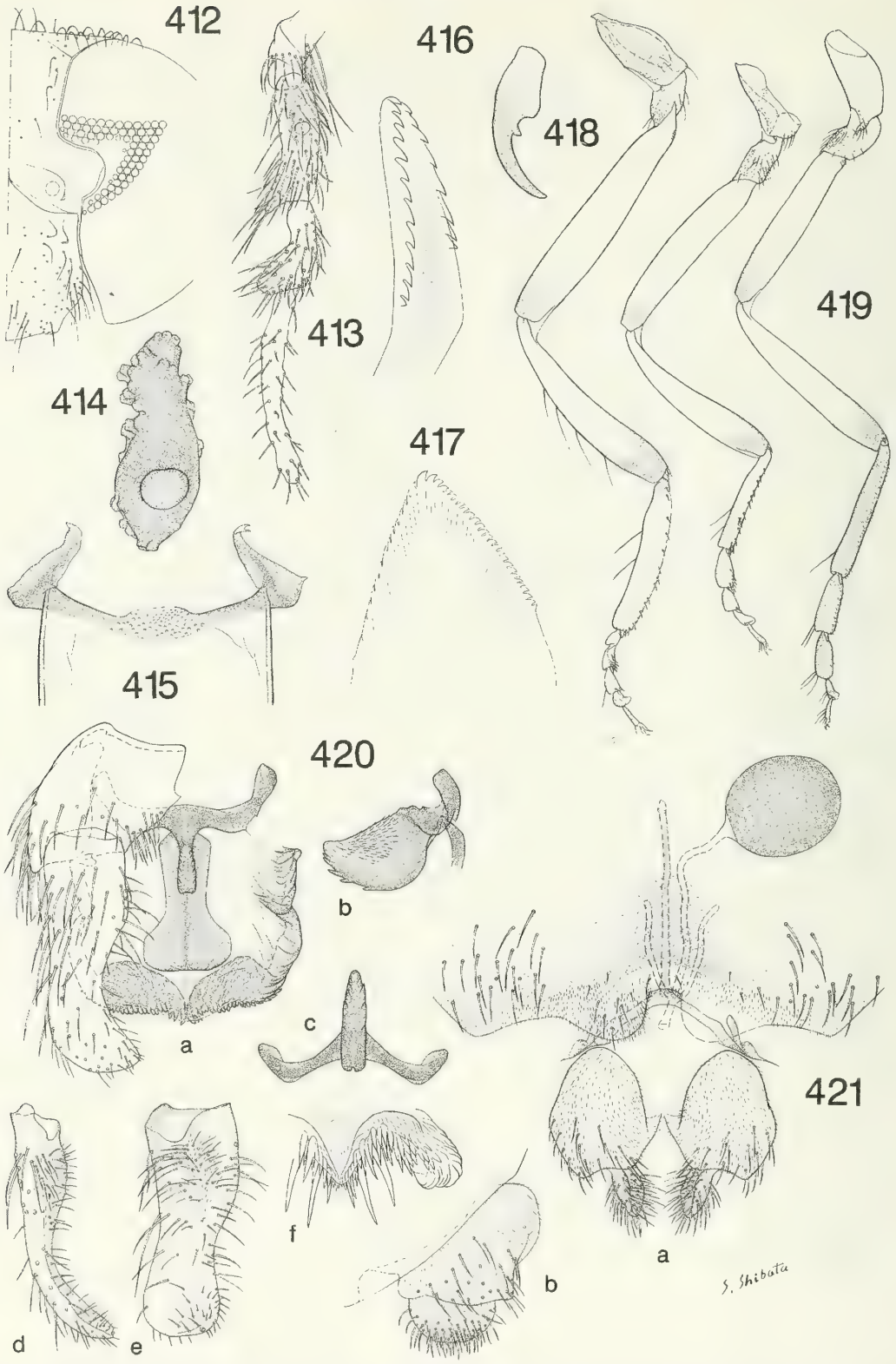
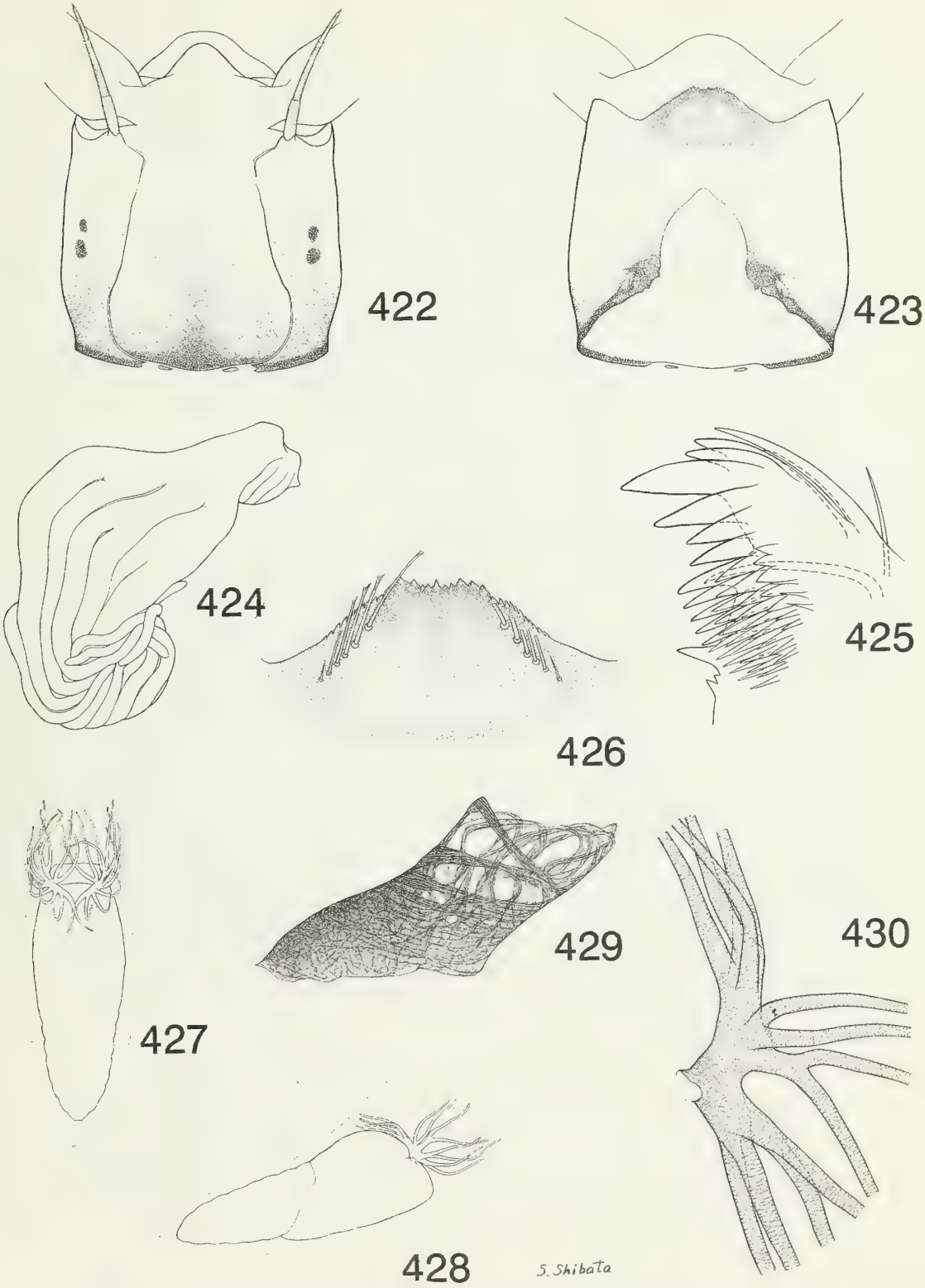


411

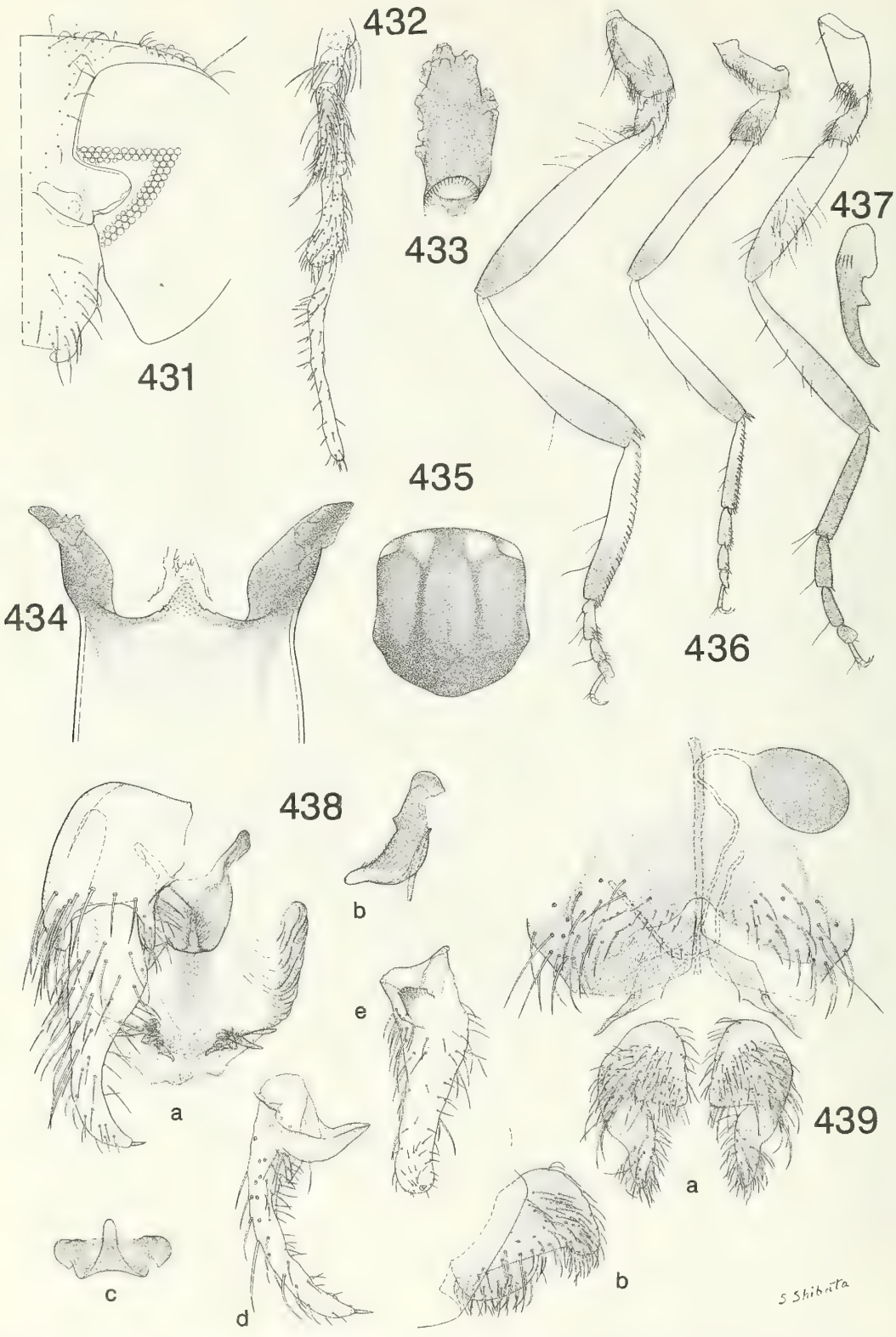
Figs. 405-411. *Simulium* (*Simulium*) *decorum*. 405. Head capsule of larva, dorsal view. 406. Head capsule of larva, ventral view. 407. Hypostoma of larva. 408. Tip of larval mandible. 409. Respiratory histoblast of mature larva. 410. Cocoon with pupa. 411. Basal portion of pupal respiratory organ.



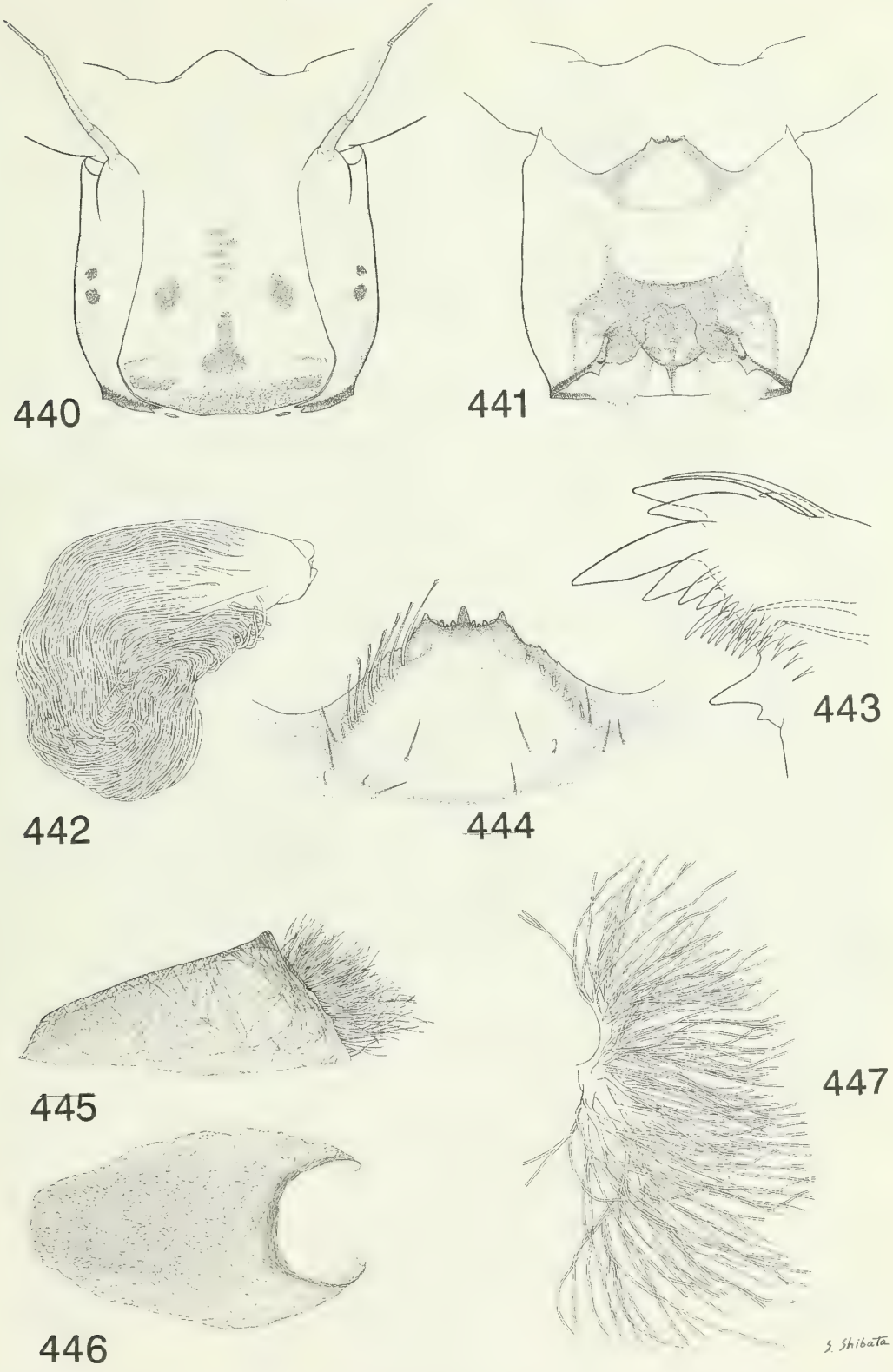
Figs. 412-421. *Simulium* (*Simulium*) *defoliarti*. 412. Head of female. 413. Palpus of female. 414. Sensory vesicle of female, enlarged. 415. Proximal end of female cibarium showing armature. 416. Tip of blade of maxilla of female. 417. Tip of female mandible. 418. Claw of female. 419. Hind, mid-, and forelegs of female. 420. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus; f) Tip of arm of paramere. 421. Terminalia of female: a) ventral view; b) lateral view.



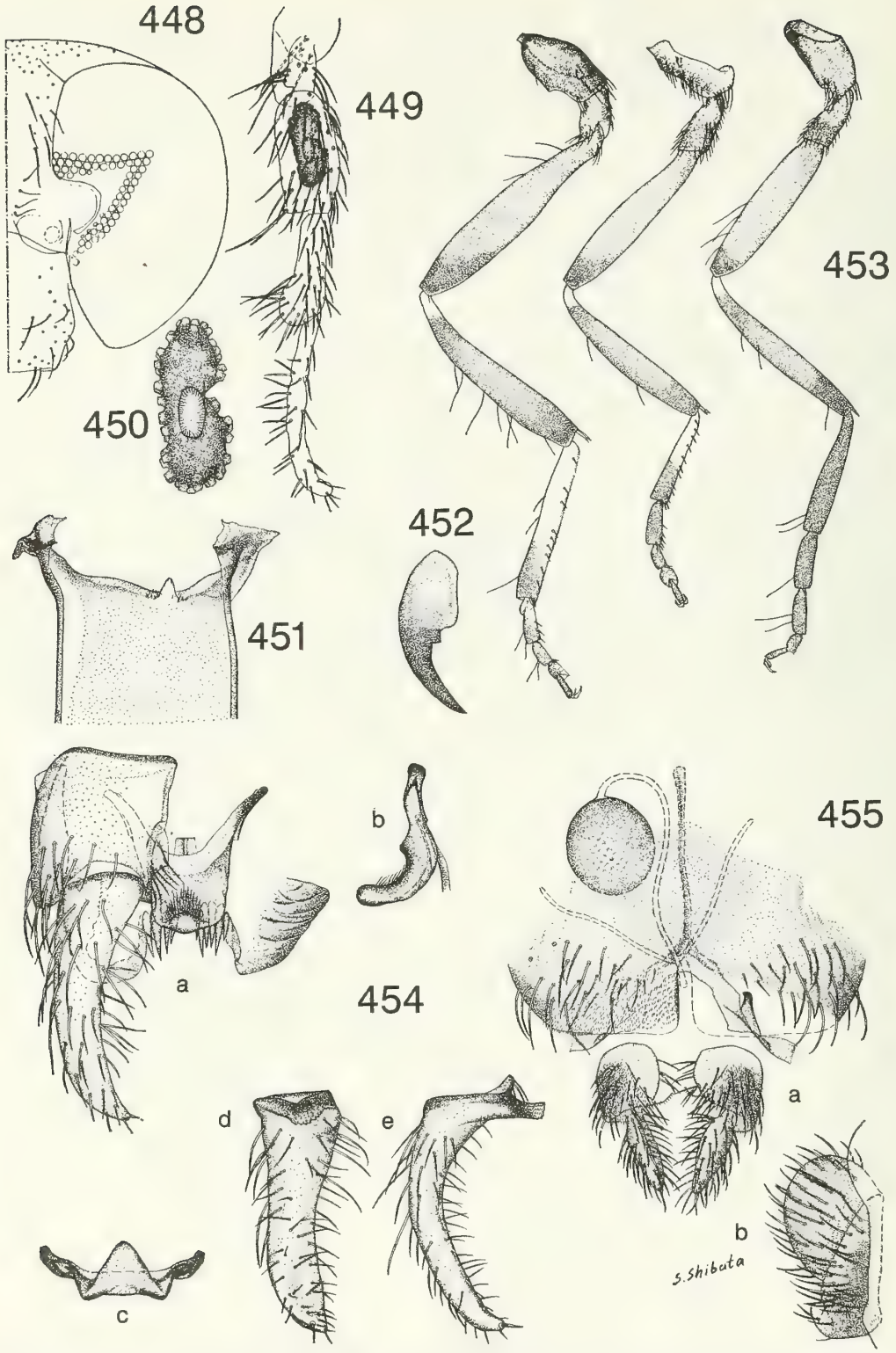
Figs. 422-430. *Simulium* (*Simulium*) *defoliarti*. 422. Head capsule of larva, dorsal view. 423. Head capsule of larva, ventral view. 424. Respiratory histoblast of mature larva. 425. Tip of larval mandible. 426. Hypostoma of larva. 427. Outline of cocoon with pupa, dorsal view. 428. Outline of cocoon with pupa, lateral view. 429. Cocoon of pupa. 430. Basal portion of pupal respiratory organ.



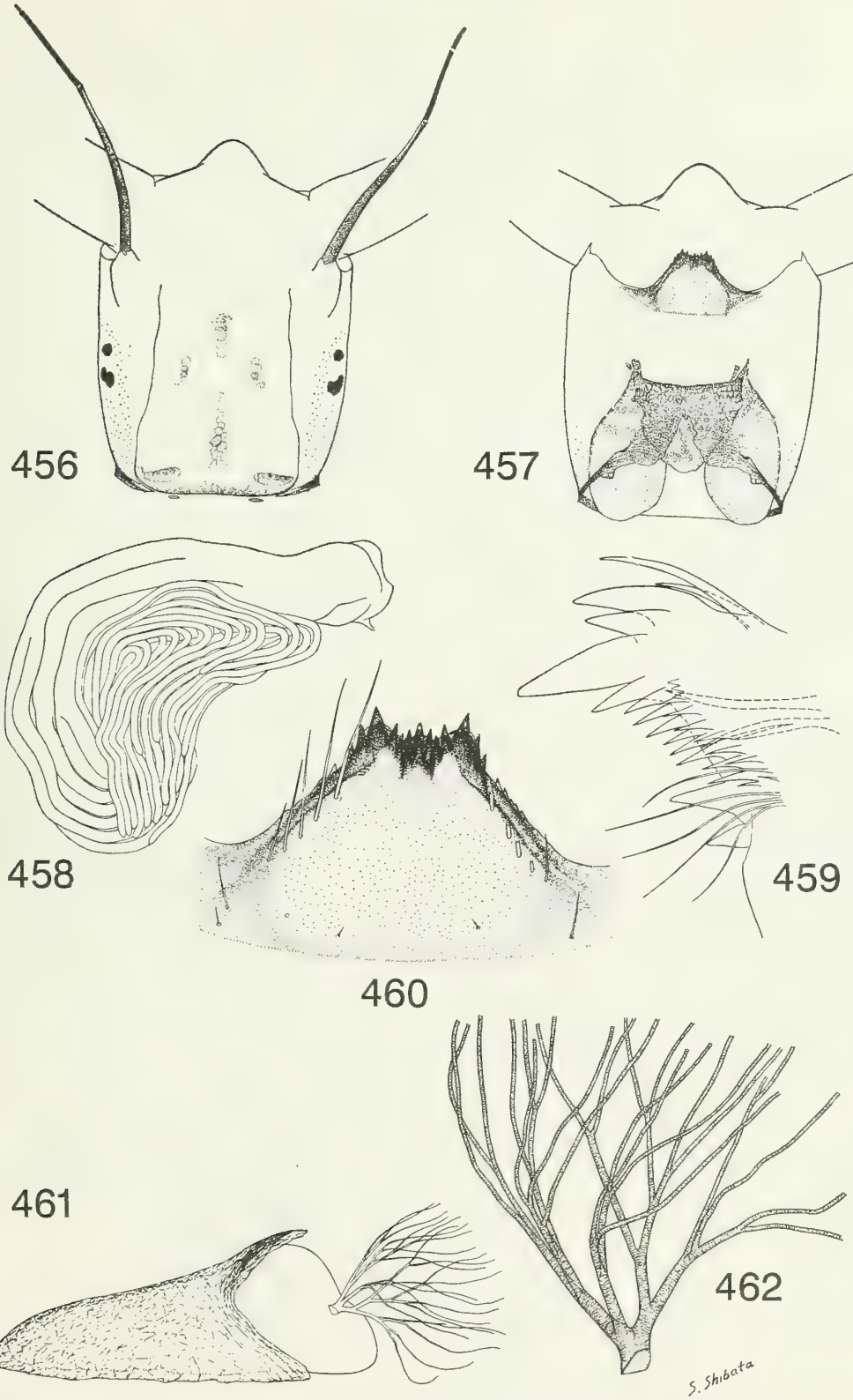
Figs. 431-439. *Simulium* (*Simulium*) *hunteri*. 431. Head of female. 432. Palpus of female. 433. Sensory vesicle of female, enlarged. 434. Proximal end of female cibarium showing armature. 435. Female thorax, dorsal view. 436. Hind, mid-, and forelegs of female. 437. Claw of female. 438. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 439. Terminalia of female: a) ventral view; b) lateral view.



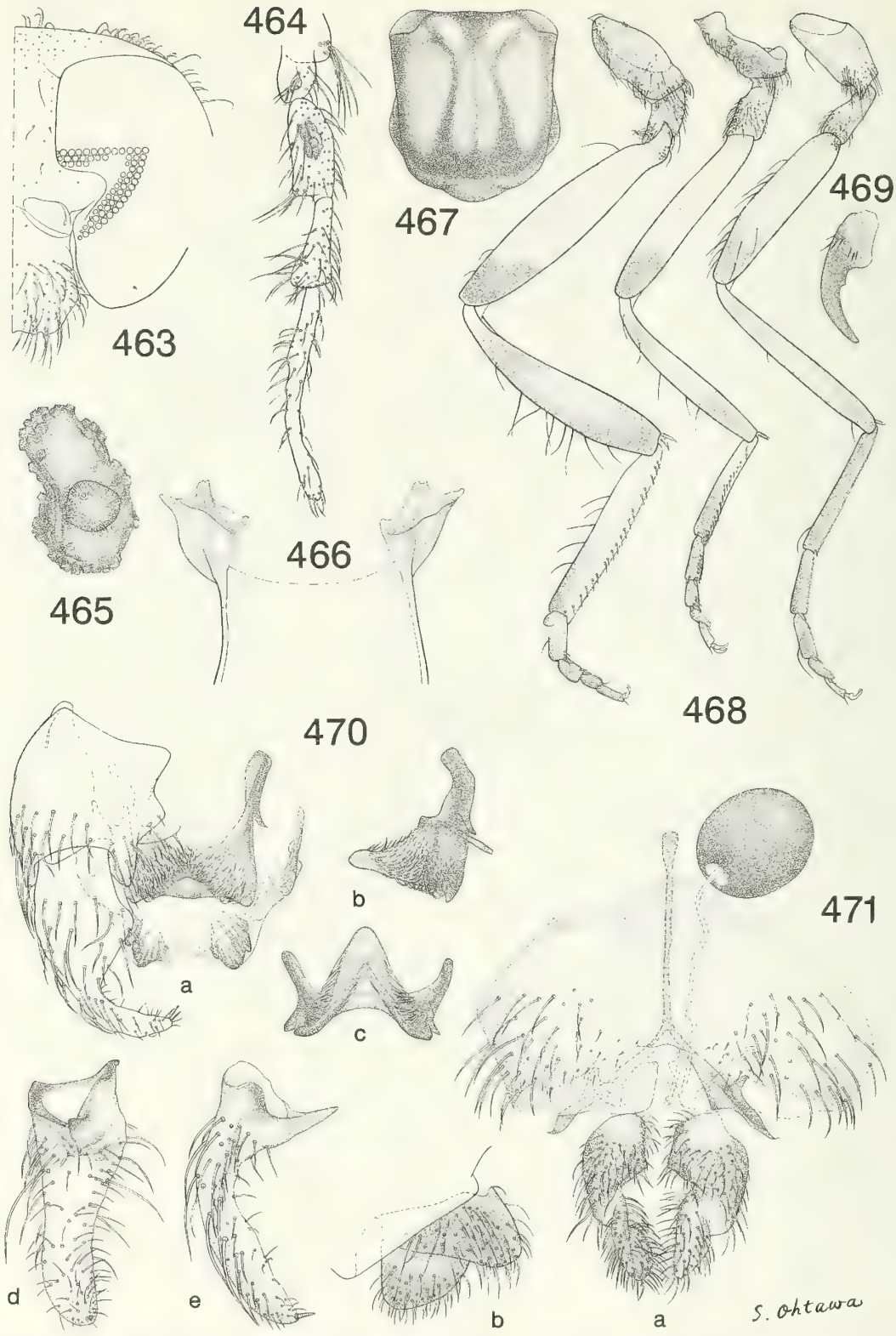
Figs. 440-447. *Simulium* (*Simulium*) *hunteri*. 440. Head capsule of larva, dorsal view. 441. Head capsule of larva, ventral view. 442. Respiratory histoblast of mature larva. 443. Tip of larval mandible. 444. Hypostoma of larva. 445. Cocoon with pupa, lateral view. 446. Cocoon, dorsal view. 447. Pupal respiratory organ.



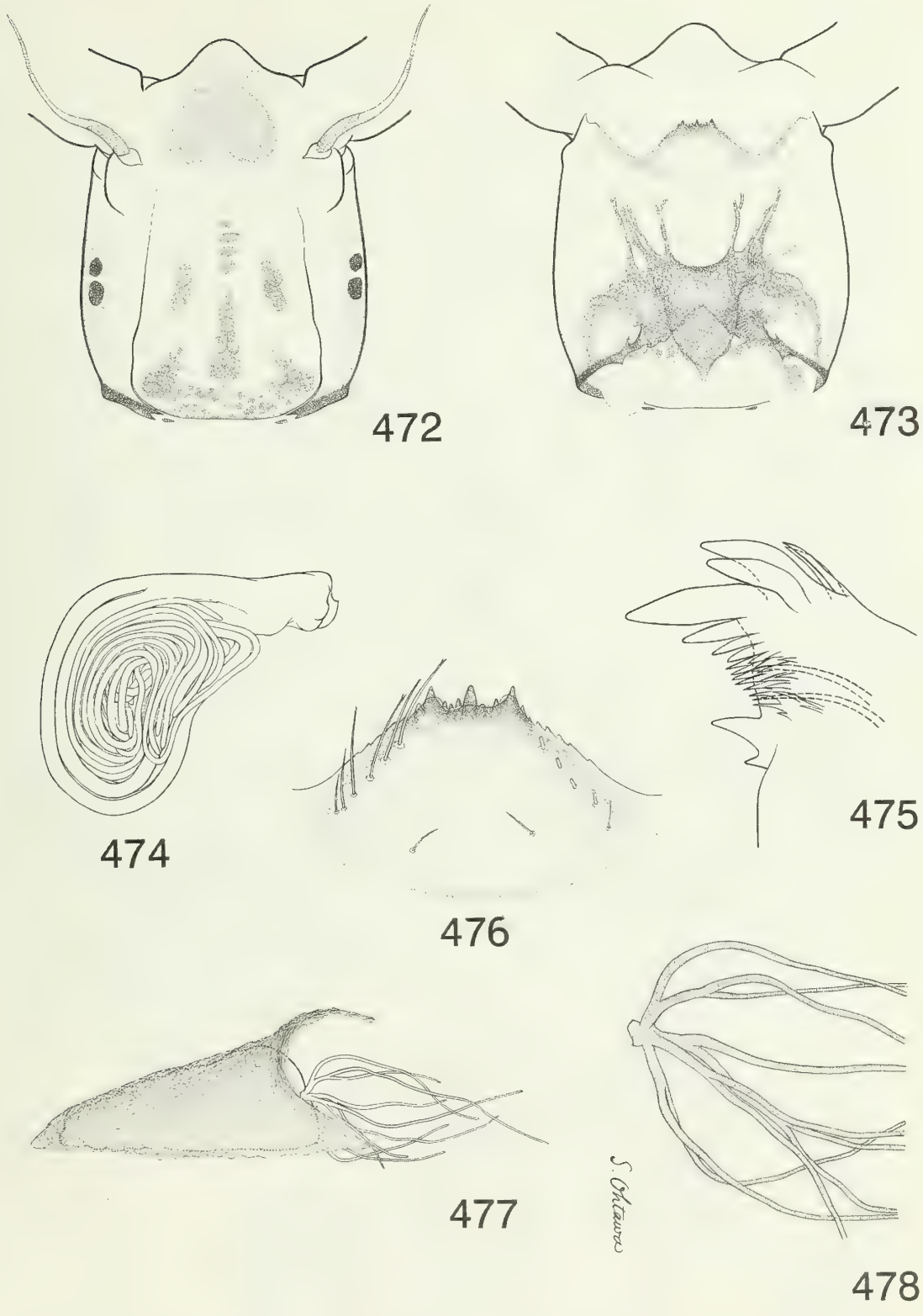
Figs. 448-455. *Simulium* (*Simulium*) *jacumbae*. 448. Head of female. 449. Palpus of female. 450. Sensory vesicle of female, enlarged. 451. Proximal end of female cibarium showing armature. 452. Claw of female. 453. Hind, mid-, and forelegs of female. 454. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) inner view of left gonostylus; e) lateral view of gonostylus. 455. Terminalia of female: a) ventral view; b) lateral view.



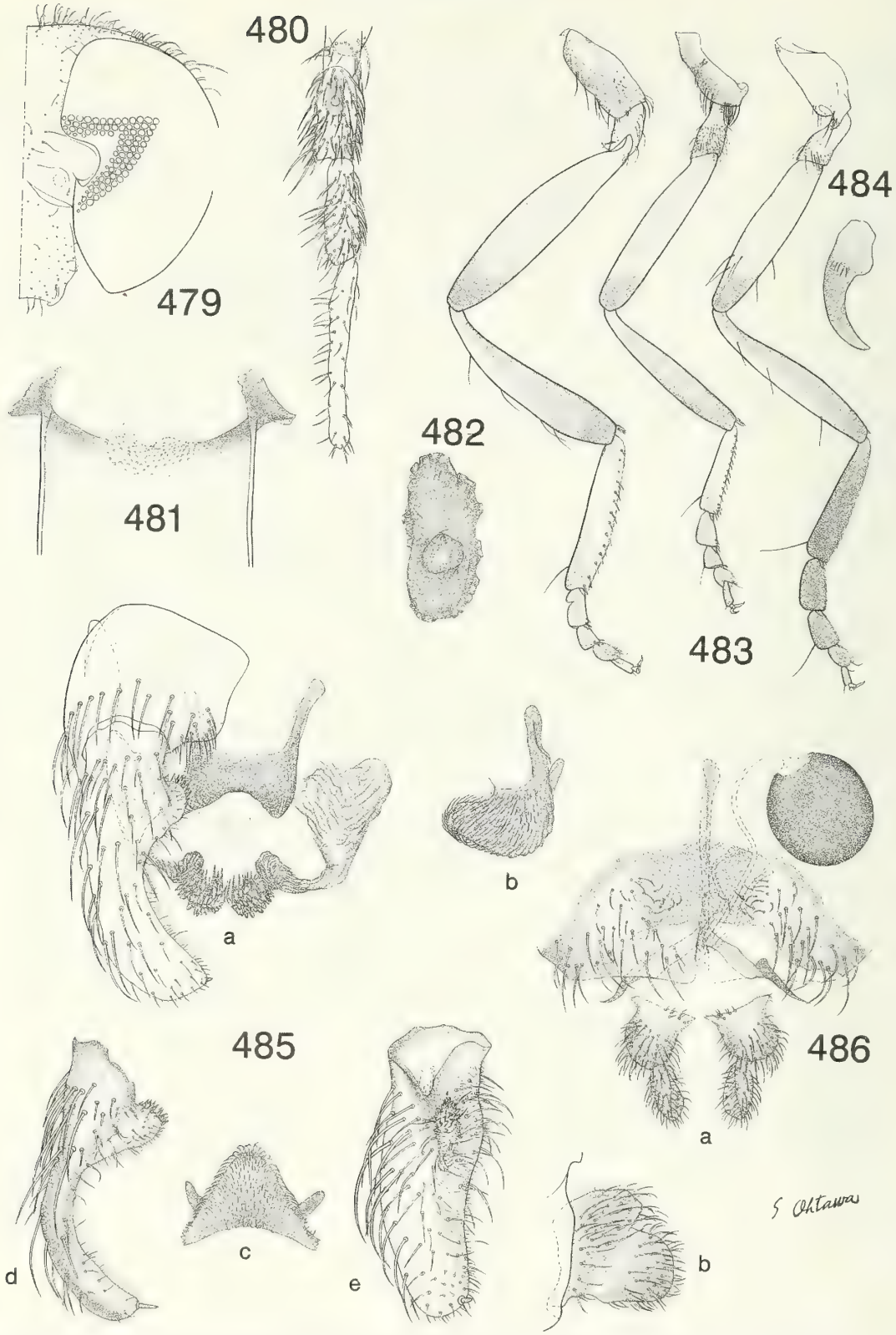
Figs. 456-462. *Simulium* (*Simulium*) *jacumbae*. 456. Head capsule of larva, dorsal view. 457. Head capsule of larva, ventral view. 458. Respiratory histoblast of mature larva. 459. Tip of larval mandible. 460. Hypostoma of larva. 461. Cocoon with pupa. 462. Pupal respiratory organ.



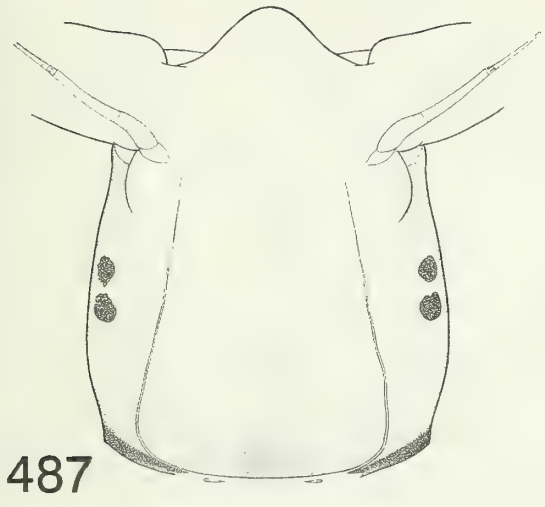
Figs. 463-471. *Simulium (Simulium)* piperi. 463. Head of female. 464. Palpus of female. 465. Sensory vesicle of female, enlarged. 466. Proximal end of female cibarium. 467. Female thorax, dorsal view. 468. Hind, mid-, and forelegs of femle. 469. Claw of female. 470. Terminalia of male: a) ventral view; b) lateral view; c)terminal (end) view; d) inner view of left gonostylus; e) lateral view of gonostylus. 471. Terminalia of female: a) ventral view; b) lateral view.

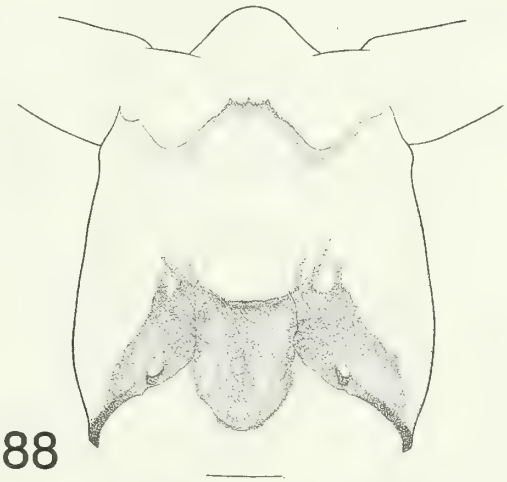


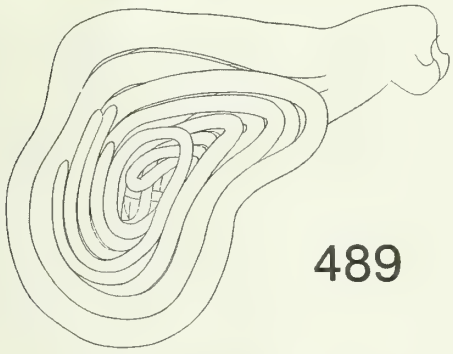
Figs. 472-478. *Simulium* (*Simulium*) *piperi*. 472. Head capsule of larva, dorsal view. 473. Head capsule of larva, ventral view. 474. Respiratory histoblast of mature larva. 475. Tip of larval mandible. 476. Hypostoma of larva. 477. Cocoon with pupa. 478. Basal portion of pupal respiratory organ.

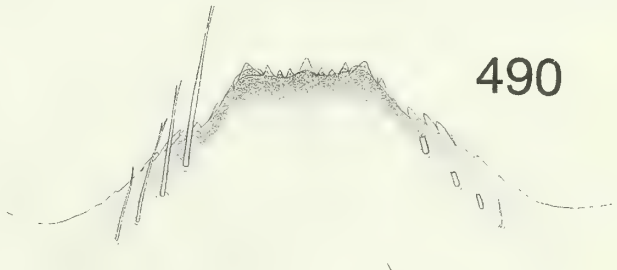


Figs. 479-486. *Simulium* (*Simulium*) *tuberosum*. 479. Head of female. 480. Palpus of female. 481. Proximal end of female cibarium showing armature. 482. Sensory vesicle of female, enlarged. 483. Hind, mid-, and forelegs of female. 484. Claw of female. 485. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d). lateral view of gonostylus; e) inner view of left gonostylus. 486. Terminalia of female: a) ventral view; b) lateral view.

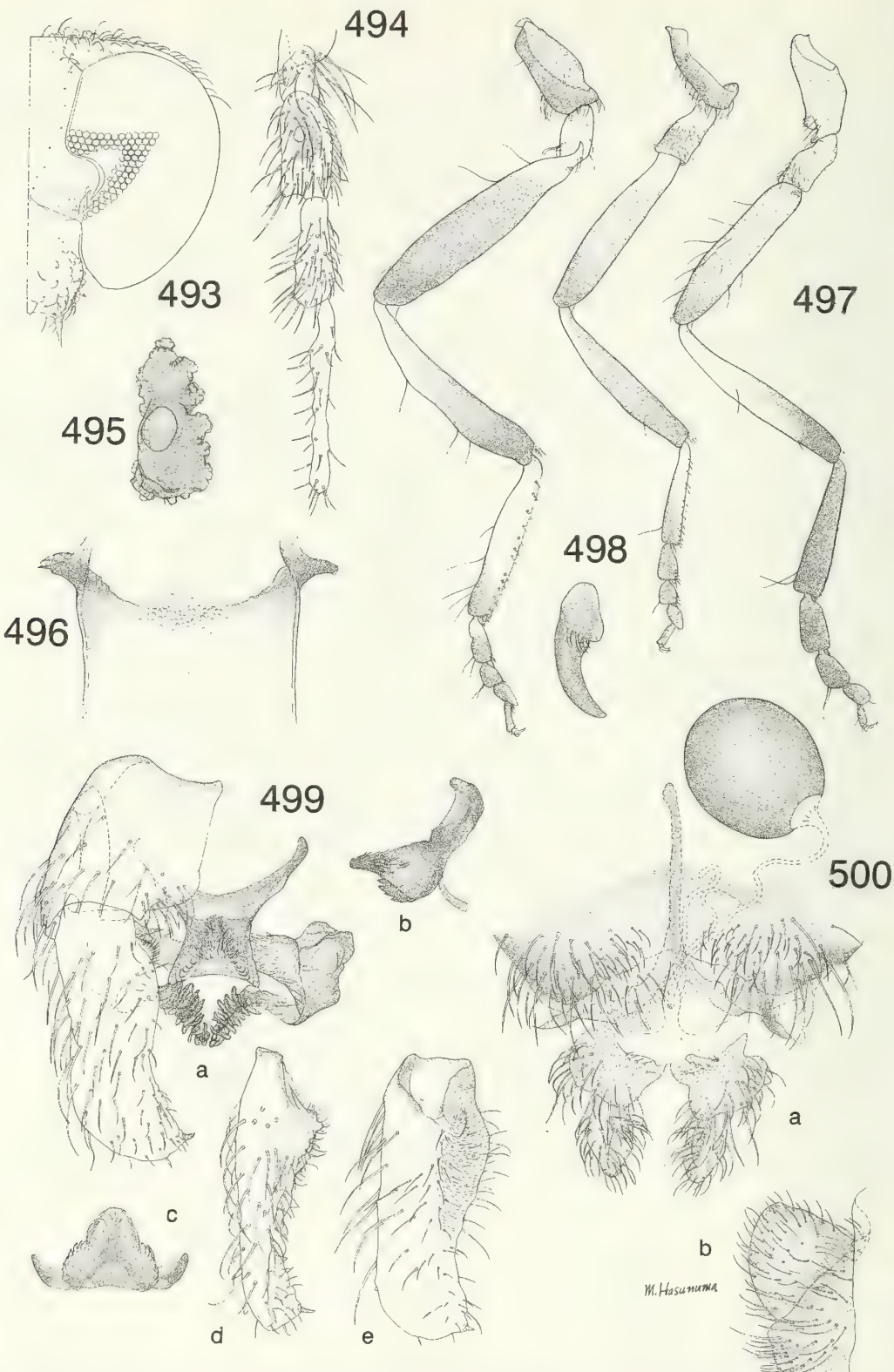




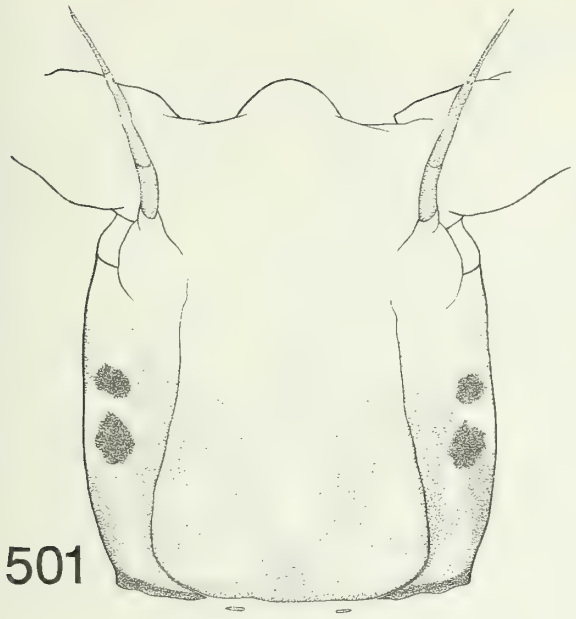


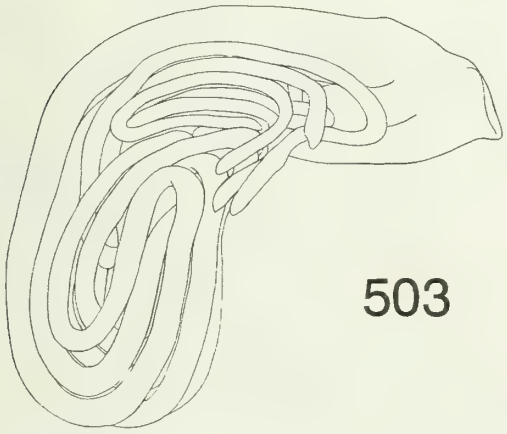


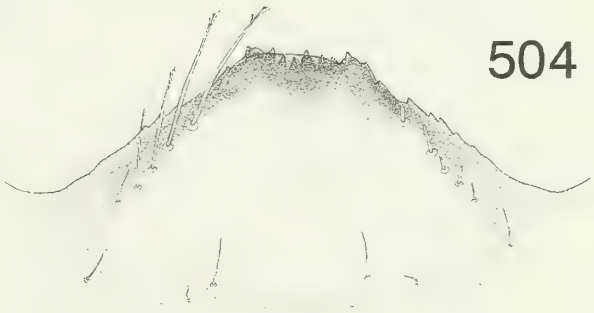
Figs. 487-492. *Simulium* (*Simulium*) *tuberosum*. 487. Head capsule of larva, dorsal view. 488. Head capsule of larva, ventral view. 489. Respiratory histoblast of mature larva. 490. Hypostoma of larva. 491. Basal portion of pupal respiratory organ. 492. Cocoon with pupa.

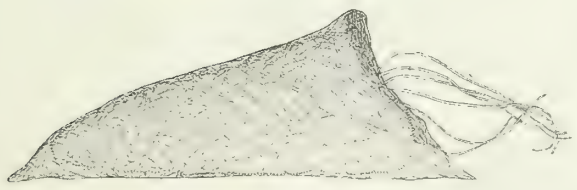


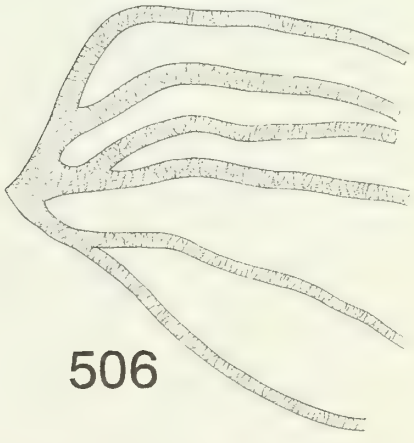
Figs. 493-500. *Simulium* (*Simulium*) *venustum*. 493. Head of female. 494. Palpus of female. 495. Sensory vesicle of female, enlarged. 496. Proximal end of female cibarium showing armature. 497. Hind, mid-, and forelegs of female. 498. Claw of female. 499. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 500. Terminalia of female: a) ventral view; b) lateral view.



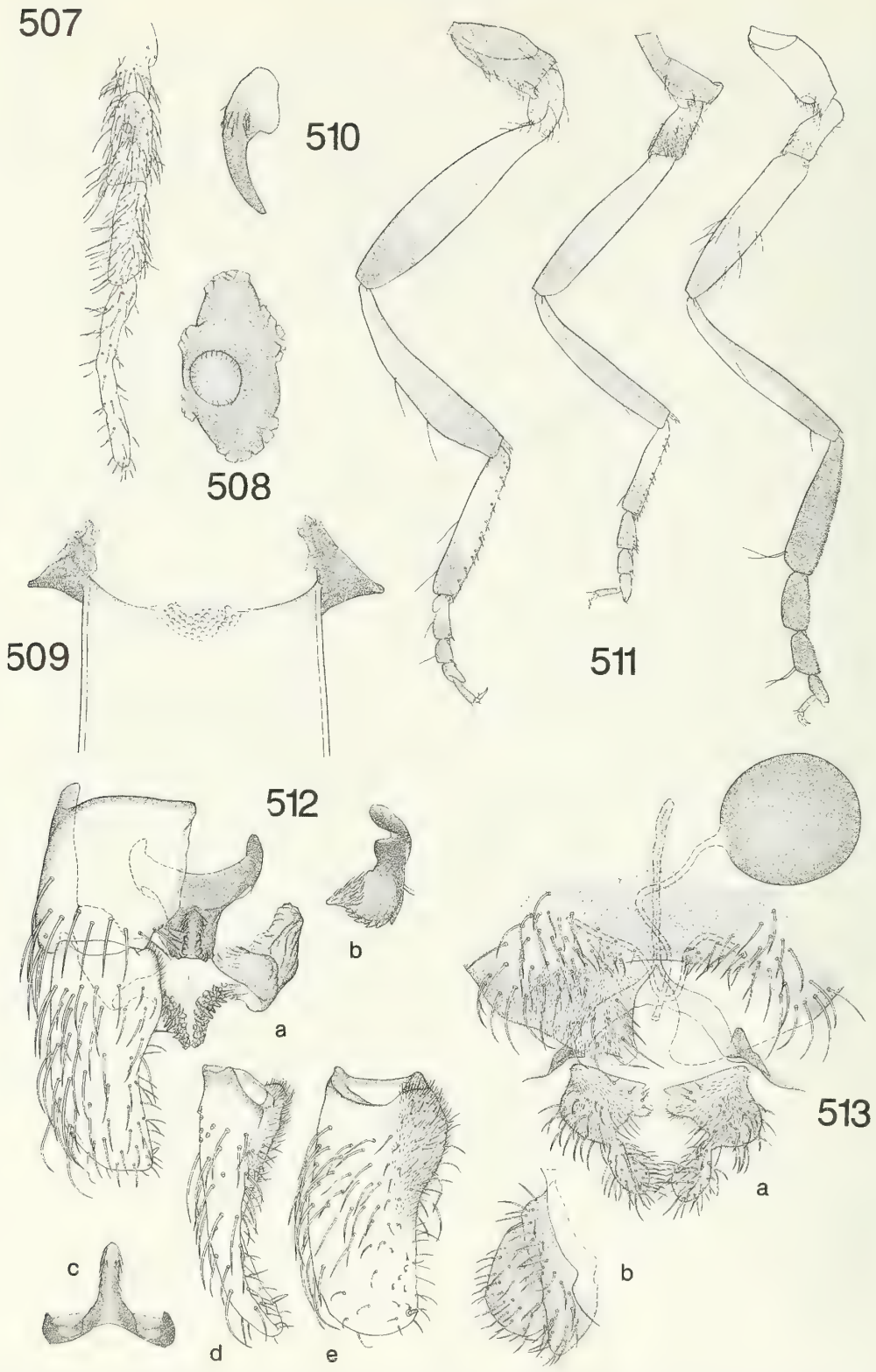




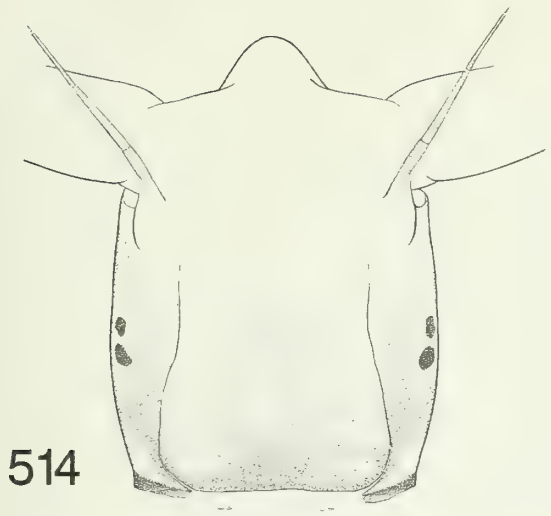


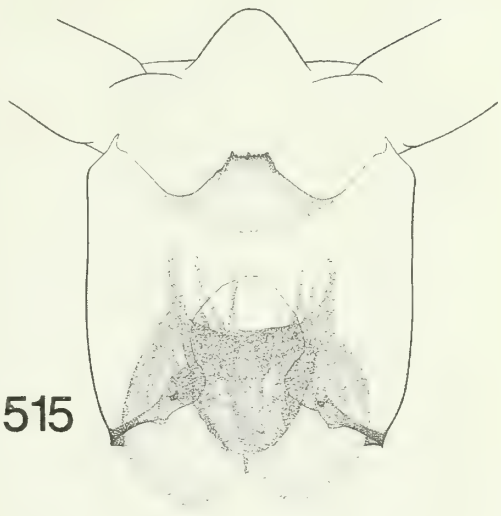


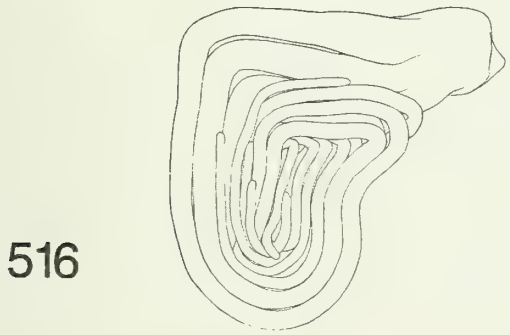
Figs. 501-506. *Simulium* (*Simulium*) *venustum*. 501. Head capsule of larva, dorsal view. 502. Head capsule of larva, ventral view. 503. Respiratory histoblast of mature larva. 504. Hypostoma of larva. 505. Cocoon with pupa. 506. Basal portion of pupal respiratory organ.

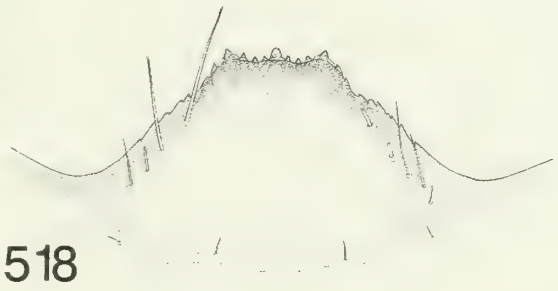


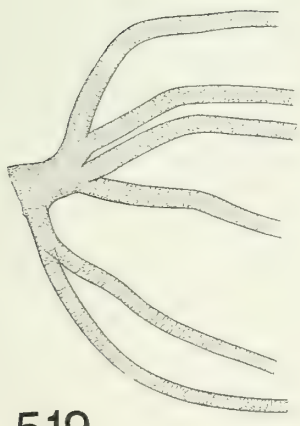
Figs. 507-513. *Simulium* (*Simulium*) *verecundum*. 507. Palpus of female. 508. Sensory vesicle of female, enlarged. 509. Proximal end of female cibarium showing armature. 510. Claw of female. 511. Hind, mid-, and forelegs of female. 512. Terminalia of male: a) ventral view; b) lateral view; c) terminal (end) view; d) lateral view of gonostylus; e) inner view of left gonostylus. 513. Terminalia of female: a) ventral view; b) lateral view.

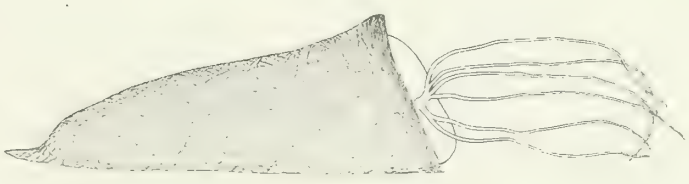












Figs. 514-520. *Simulium* (*Simulium*) *verecundum*. 514. Head capsule of larva, dorsal view. 515. Head capsule of larva, ventral view. 516. Respiratory histoblast of mature larva. 517. Tip of larval mandible. 518. Hypostoma of larva. 519. Basal portion of pupal respiratory organ. 520. Cocoon with pupa.

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